

# AGRICULTURAL ENGINEERING

Published by the AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

Headquarters of the Society: Saint Joseph, Michigan

ARNOLD P. YERKES, President

RAYMOND OLNEY, Secretary-Treasurer

VOLUME 18

SEPTEMBER 1937

NUMBER 9

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Published monthly by the American Society of Agricultural Engineers. Publication office at Benton Harbor, Michigan. Editorial and advertising departments at the headquarters of the Society, St. Joseph, Michigan . . . Price \$3.00 a year, 30 cents a copy; to members \$2.00 a year, 20 cents a copy. Postage to countries to which second-class rates do not apply, \$1.00 additional . . . The Society is not responsible for statements and opinions contained in papers published in this journal; they represent the views of the individuals to whom they are credited and are not binding on the Society as a whole . . . Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921 . . . The title AGRICULTURAL ENGINEERING is registered in U. S. Patent Office. Copyright, 1937, by American Society of Agricultural Engineers.

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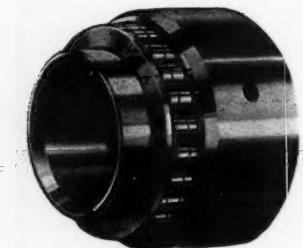
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# AGRICULTURAL ENGINEERING

VOL 18, NO 9

EDITORIALS

SEPTEMBER 1937

## Agricultural Engineering Publications

LESS THAN ten per cent of the authors of federal and state publications on agricultural engineering are definitely agricultural engineers, as indicated by membership in the American Society of Agricultural Engineers. They are the authors of less than twenty per cent of the public service literature on the subject. This is shown by a study of the bibliography on agricultural engineering recently published by the U. S. Bureau of Agricultural Engineering.

Even after appropriate qualification of the above percentages, some interesting inferences are possible. Some of the 2306 authors counted were agricultural engineers who have passed on to other worlds or other fields. Some are recognizable as men trained in agricultural engineering who have not seen fit to maintain representation in the American Society of Agricultural Engineers. Many are well-known names in other fields of agricultural science or engineering. This is partly due to the fact that some other definitely recognized fields, such as farm management, are, for the purposes of this bibliography, included in it.

It must be remembered, too, that this bibliography includes publications dating back to the nineteenth century, and many in the early twentieth century, before agricultural engineering was well recognized as a distinct field, and before many agricultural engineers were available to write necessary bulletins on the subject.

With due allowance for all these considerations, how-

ever, it seems apparent that many men in related fields have been, and still are, going close to or over the indistinct border into agricultural-engineering phases of their subjects.

How well qualified they may be to write on the agricultural-engineering angles of their respective fields, or how valuable their contributions may be, we are in no position to say. Their attempts may have been justified by results, by public demand, by the pre-occupation of agricultural engineers with other problems, by actual lack of agricultural engineers, by lack of support for agricultural-engineering work along the lines indicated, by failure of cooperation between the departments concerned, or by any of several combinations of circumstances and sins of omission or commission.

With the present supply, distribution, and general availability of agricultural engineers, a point to be watched by them, and by administrators of public funds, is indicated. In any specific case of border-line work between agricultural engineering and another field, who is best qualified to do it, or any part of it, most effectively? What may be the logical division of the work, or organization for cooperation in the public interest? Agricultural engineers may need to indicate more clearly the agricultural-engineering nature of certain problems in related fields, their qualifications and availability for work on those problems, and their willingness to cooperate.

## Big Problems for Agricultural Engineers

WHAT ARE some of the big problems facing agricultural engineers today? While the field is varied, and more truly identified by an interwoven multitude of small problems, there are generally some few major classes of technical problems or opportunities before the group. With no attempt to place them in any estimated order of relative importance, we name some that come to mind.

An engineering analysis of agriculture, as proposed by Dr. E. A. White and, we believe, undertaken by him in some degree so far as rural electrification is concerned, could be a big and professionally profitable proposition. Agriculture is our field; engineering, our technique; and analysis, a major factor in that technique. But how far have agricultural engineers gone in analyzing agriculture as an engineering proposition? Dr. White has pointed out some important "unknowns." If agricultural engineers are to really occupy and fully serve their field, and thereby preempt it, some further analytical outlook on agriculture is implied.

Farm operating efficiency studies by the U. S. Bureau of Agricultural Engineering have shown a big undeveloped area of opportunity in farm production economics, involving agricultural engineering as an organization, equipment, and operations factor, along with other agricultural sciences. It is an opportunity to work in close cooperation

with farmers on their immediate problems, and to earn their confidence and support.

C. O. Reed's concept of agricultural engineering as the engineering inherent in agricultural biology, commands thought as a revolutionary premise in the field, with strong support and far-reaching implications. It warrants further analysis and either rejection or acceptance, with the revisions of policy and practice which such acceptance would indicate.

Chemurgic progress is continually creating new opportunities for agricultural engineers. Its economic thesis of useful production and meeting new needs with the organic products of agriculture, fits in well with engineering faith in efficient operation, low-cost production, and mass consumption as contributing factors to high living standards and progressive civilization. It needs engineering at the source of supply of the organic substances to be used as raw materials in industry.

These are just a few current major, inspirational angles to agricultural engineering, as we see it. It would be interesting to learn what others may think are today's major problems and opportunities in the field, why they are important, and what might be done about them. This should be a professionally desirable line of thought. Contributions are invited.

## Simultaneous Operations

**G.** D. JONES has hinted at the prospect of further combining agricultural operations to minimize the number of required times over the ground to produce and harvest any given crop.

Between some operations there is necessarily a time lag imposed by biological, soil-conditioning, or crop-conditioning requirements. The grain combine cannot profitably follow along immediately behind the drill. But the grain combine has provided an example of how a time lag, due to a customary crop-conditioning process, can be avoided. Possibly there are some other time lags in agricultural operations that can profitably be avoided.

Is there any biological requirement of a time lag between various soil-conditioning operations, and between them and crop planting? Where this may be the case definite proof by research would seem desirable. Otherwise the field might well be considered open for mechanical development of soil-conditioning and planting combines; or of combination hitches for simultaneous use of existing preparation and planting units.

It seems possible that with many crops, operations during the growing stage could be reduced in number and cost

by combining functions performed on each trip through the field. The functions to be accomplished may include moisture conservation, and weed, pest, and disease control, together with positive steps to improve crop development. Necessary timing for effectiveness will limit the combining possibilities, but should still leave opportunities worth investigating.

Combine development in harvesting operations is farthest advanced. But new crops; new storage methods; harvesting at immature stages of development; harvesting perishable products; and new cleaning, grading, and preservation principles offer opportunity for further economical combination of mechanical operations and operating equipment.

Combine possibilities run through the whole crop cycle, from seed treatment before planting to cleaning, curing, and storage of the harvested crop. While it has its limitations, the combine idea is a basic concept in farm-equipment development. Every two or more functions which might be performed at the same time on the same materials, or over the same area, invite investigation of the possibilities of their being combined.

## Perilla Harvesting

**O**PPORTUNITY for agricultural engineers to contribute to farm chemurgic progress in connection with perilla oil production was pictured by Williams Haynes at the third national farm chemurgic conference. In his own words, "This oil is produced from the tiny seeds of a plant of the mint family. It is a slow-growing annual which needs a long growing season, so that it presents another chemurgic opportunity for the southern states, and, again, an opportunity that cries aloud for Yankee invention to perfect a harvesting machine. From a few thousand pounds two years ago, our imports from Japan will exceed 150 million pounds in 1937."

Perilla is of further significance to American agriculture in that it combines well with soybean oil, favoring increased use of the latter in paints and varnishes.

The increasing volume of perilla consumption and the possibility of growing it in the United States indicate a genuine economic opportunity for a practical harvester. Other difficult harvesting problems have been solved mechanically. Various small seeds are harvested mechanically, from the standing stalk in some cases, by heading and threshing, by harvesting the whole stalk and threshing, or by vacuum pick-up.

Without detailed knowledge of the problems of perilla harvesting, but based on confidence in the ability of agricultural engineers to solve mechanical harvesting problems, we believe some agricultural engineer can solve this particular one, with credit and profit to himself, to his profession, to American agriculture and to American industry.

## Engineering Remuneration

**T**HREE IS little reward in being a poor engineer, according to the latest published summary of the U. S. Bureau of Labor Statistics survey of the engineering profession. This fact might, if it were made known to them, exercise both a selective and stimulating influence on embryo engineers entering college at this season, either for the first time or to continue their engineering training.

It is inevitable that there always be a lower fringe of the engineering profession. In any heterogeneous group, some must be least effective. But the lower fringe of engineers need not be less in demand or have lower earning power than the upper fringe of skilled labor, as revealed in the above mentioned report. The effectiveness and economic worth of the lower fringe of engineers might gradually be increased by higher entrance and graduation requirements in the colleges, by registration of engineers, and by emphasizing to students and prospective students the true requirements of their chosen profession, and its rewards for various grades of performance therein.

It is neither easy to raise the bars to the profession, in the face of evident need of good engineers, nor to disil-

lusion young hopefuls with romantic aspirations to engineering greatness. The latter course, however, offers the advantage of shifting, to the shoulders of the would-be engineer, at least a part of the burden of responsibility for following his chosen path in the face of facts, and for doing his best therein if his choice of life work remains unchanged.

Some, if not all, doubtful aspirants to engineering education can be dissuaded and directed toward other lines of endeavor in which they may find greater satisfaction and usefulness. Those unhesitatingly committed to and mentally qualified for development as engineers now have available an additional and better index to the financial rewards the profession offers for varying degrees of experience and achievement.

The Bureau of Labor Statistics' report on "Income and Earnings in the Engineering Profession" should help correct the situation it reveals, if made known to students and prospective students, by deterring some of the poorly qualified, and by stimulating those who have in them "the makings" of good engineers.

# Quick-on and Quick-off Power-Farming Equipment

Contribution by R. H. Wileman

THE ADVENT of the farm tractor powered by the internal-combustion engine for the diversified farming areas was based on the idea of literally replacing the horse. It was designed with the idea that it was to pull horse-drawn tools the same as the horse did.

It was soon found, however, that horse-drawn equipment was not strong enough, nor would it adapt itself to use with tractor power. As a result of this experience what we commonly know as the four-wheel conventional type of tractor came into being. Supplied with plows, disks and similar tools of suitable size, strength, and design, the conventional type of tractor made the first real advancement in mechanized agriculture.

It was soon realized, however, that if the tractor was to be used extensively as a source of power on the farm, it had to be capable of adapting itself to a wider range of uses than was possible with this type of tractor.

The development of the general-purpose tractor was the answer to this demand, and it made possible the use of mechanical power for nearly all field operations. It was now the implement designers' turn to produce their wares. The tractor engineers' attempt to fit the tractor to horse-drawn implements had not been successful because this equipment did not prove adequate for tractor use. The next step was the development of a type of tractor which would do the job, and it was for the implement designer to meet the challenge and provide suitable cultivators, planters, mowers, listers, middle busters, and other tools which would fulfill the requirements of this new idea in tractor design.

In the design of these implements some of the most important things to be considered are the following: (1) They must be sturdy enough to stand the power and speed of the tractor, yet have flexibility and be easy to operate. (2) They must be adaptable to a wide variety of crop, soil, and topographic conditions. (3) The cost must be kept down to a point where this equipment can be used economically on small acreages. (4) The tractor driver must be able to operate the implement he is using as well as the tractor, and do it from the tractor seat. This last requirement means that the implement in many cases be mounted entirely or at least partially on the tractor itself.

On the average and smaller than average size farms, and with the diversified type of farming that is generally practiced, there is not suffi-

Presented before the Power and Machinery Division at the annual meeting of the American Society of Agricultural Engineers at Urbana, Illinois, June 23, 1937.

Author: Department of agricultural engineering, Purdue University. Assoc. Mem. ASAE.

cient acreage to keep the tractor busy doing one operation for any considerable period of time. This requires that the available tractor power be changed frequently from one implement to another. It is not hard to imagine a case where a farmer would want to use his general-purpose tractor on the mower in the morning, cultivate during midday, rake or load hay in the late afternoon, and grind feed the same evening. When equipment mounted on the tractor is used, it must be partially or entirely removed in most cases before some other tool can be attached.

The fifth requirement is that any equipment used under conditions which require frequent changes from one machine to the other, must be so designed that it can be quickly and easily attached to or removed from the tractor.

In order that we may better realize the needs for power farming equipment which can be quickly attached to or removed from the tractor, let us consider for a moment the average number of crop acres per farm in the United States. According to the 1935 census the average size of farm in the United States was 154.8 acres. Of this but 34 per cent was used for crops, or an average of 53.6 acres. We might get a little more vivid picture if we stop to consider that the average acres per farm used for all crops during 1934 in the state of Illinois was approximately 83 acres, Iowa 90 acres, and Indiana 55 acres per farm. With these figures in mind and with our diversified type of farming, the acreage of any single crop must of necessity be small. It is, therefore, self-evident that if the general-purpose tractor is going to approach its limits of possible usefulness on the farm, frequent changes of equipment are imperative.

The necessity for making these frequent changes naturally comes during the farmers busiest season, so that it must be possible to attach or remove the equipment in a few minutes time. The demand for quick-on and quick-off equipment is most pressing with the tools for the smaller size tractors, as these tractors are found on the smaller farms. This feature should not be disregarded in the equipment for the larger tractors, however, especially in tools such

as cultivators and mowers which are used more or less intermittently over a considerable period of time.

From the standpoint of the user of quick-on and quick-off power farming equipment, some of the more important features desired are (1) satisfactory method of attachment, (2) low cost, (3) stability when off the tractor, (4) movability when detached, and (5) small storage space requirement.

The method of attaching this type of equipment should be such that it gives rigidity, can be quickly made by one person, and requires a minimum number of tools. It should be possible to attach or remove the implement without having to crawl under, over, or through it.



The greatest demand for low cost in power equipment comes from the small farm. This naturally means small acreages and limited hours of service per year. It is thus imperative that the cost be kept at a minimum without sacrificing the essential or desirable requirements in the implement itself, so that it will be economically possible for the small farm to justify this equipment.

When an implement is removed from the tractor suitable and adequate supports should be provided which can be quickly adjusted so that they will support the tool and keep it in its proper position for reattachment. These supports should be integral with the implement rather than separate, so they will be at hand when needed and not in the shed at the other side of the farm or hanging on the fence where last used. Experience with quick-on and quick-off equipment definitely points out the lack of stability when detached as the most severe criticism of some of these implements.

A tool removed from the tractor is not immune to being bumped and with inadequate supports will often fall over and twist itself into a puzzle which is not readily solved. This can easily happen when the tractor is being backed away from the tool after detachment or when being placed in position for reattachment, as well as during the intervening period of time. A little more attention to providing a suitable means of supporting the implements when they are detached from the tractor would materially benefit the quick-on and quick-off feature, and save a lot of time, trouble, and profanity on the part of the farmer.

It is often necessary or desirable to move an implement when it is not attached to the tractor. On machines which rest on legs or similar supports when not in use, the addition of small castor wheels or smooth flat surfaces on the bottom of the supporting members, so that they could be rolled or slid, would be very desirable.

The question of implement storage is a big problem on the farm. Many tools, because of their nature require a lot of room, as they do not lend themselves to being folded up or taken apart. On tools which have long protruding members provision should be made, whenever possible, for easily removing these parts. A good example of this is the lifting rods or pipes on the front section of a tractor cultivator. If some simple means could be provided for removing the extending portions, it would greatly reduce the amount of space required for storing, and in many cases prevent their being stored in the big shed, with the heavens for a roof.

The quick-on and quick-off feature in power-farming equipment originated quite early in the development of this line of tools. A mounted two-row cultivator which appeared soon after the general-purpose type of tractor was, to my knowledge, the first piece of equipment to have this feature. It did not keep pace with the development of the equipment itself, however, and apparently received but little consideration for a period of several years. Not until after the appearance of the small general-purpose tractor did it receive any great impetus.

This was a natural sequence, because, as has been previously pointed out, the need for quick and frequent

changes of equipment was magnified in the small tractor, whose size and cost placed it within the realm of the small farm.

During the last three or four years there has been a concerted effort on the part of implement designers to develop a line of quick-on and quick-off tools which would meet the requirements of small tractors and the farms they serve.

During this comparatively short period of time, at least twelve classes of power-farming equipment embodying the quick-on and quick-off feature have appeared on the market. In many of these classes we find several types of machines designed to meet the requirements of the particular crops for which they are intended.

Considering the size of many of these implements, and the amount of time required to attach or remove some of the earlier types, it is hard to realize that a complete change of equipment can now be made by one person in fifteen minutes or less.

The implement designers are to be congratulated on the fine work they have accomplished in so short a time. The least we can do is to wish them well and lend our support and assistance in every way possible toward the improvement and further development of quick-on and quick-off power-farming equipment.

### Contribution by C. W. Mott

**T**O LAY a proper foundation for this discussion it is necessary to go back about fifteen years. Prior to that time the number of implements mounted directly on tractors was quite limited. Earlier tractors had been used mostly for drawbar work such as pulling plows, disks, and other implements.

We realized quite early in our experience that cultivators drawn behind the tractor were not practical. One operator was required on the tractor and another on the cultivator. The row-crop tractor had the outstanding advantage of a short turning radius, and a trailing or drawn cultivator could not take advantage of it. We therefore soon developed a cultivator mounted directly on the tractor to take advantage of the short turning radius and eliminate one operator.

This led to other implements mounted on and carried by the tractor, for the same reasons as previously mentioned, and in most instances the implement mounted directly on the tractor was lighter and less expensive than the old implement that had its own ground wheels.

Our engineering staff is composed of a plow-designing group, a cultivator group, a mower designer, etc. The design of implements mounted on the tractor was of course undertaken by these various groups, each using their own most economical means of attaching the implement to the tractor. At that time the big problem was to design commercially successful, directly mounted implements of the various types for use in the various territories.

Author: Research engineer, International Harvester Company.



Attention was given to ease of attaching and detaching, but this feature at that time was rather secondary, as compared with the problems of design to meet field conditions in various territories that were rapidly becoming tractor-minded. Our first Farmalls had slotted brackets at the front end of the frame, and hinged bolts on the cultivator that fitted into these slots to provide a quick-on and quick-off feature which was quite comparable in speed with the best of today. I mention this to show that this feature was not entirely overlooked, even at that early date.

Some years ago we realized the necessity of quick-on and quick-off implements, as we had learned that where the farmer had one tractor and two implements, such as a cultivator and mower, he very often wished to carry on two different operations in a single day. For example, the corn belt farmer wants to cultivate during the early part of the day, and may want to cut hay a few hours and then go back to cultivating until the hay is ready to rake.

At that time eight distinct types of machines had already been developed for use on the Farmall, namely, mowers, cultivators, plows, middle busters, beet pullers, cotton and corn planters, sweep rakes, and cotton dusters.

The different models of cultivators and planters made 12 implements then available. These 12 had then been accepted by the trade. Naturally, as the number increased, a more pressing demand was apparent for easy-on and easy-off implements, and it seemed proper at that time, because of the experience that our various groups of designers had had with their respective implements, that some one common method of attaching and detaching be provided.

implements on the front end of the tractor being reasonably well taken care of in this respect, our big problem was on implements that were attached to the rear end of the tractor. Most of the designers had taken advantage of the wide drawbar by attaching the implements in various pieces to this drawbar. When the question of arriving at some common method for attaching of implements was considered, it was realized that the first move had to be made by providing some means on the tractor that would make it possible to quickly detach or attach the drawbar itself, and where an implement was depending entirely upon the drawbar, we made the drawbar a part of that implement.

The first problem was to provide some convenient and effective attaching means on the axle carrier of the tractor. This means had to be located in the most advantageous position to suit all of the various implements, and at the same time these same means that were to be used for attaching implements were also to be used for attaching the drawbar.

Because of our previous experience with these various mounted implements, we did arrive at one common method for attaching all of the implements, and an effort was made to keep the machines in complete individual units as much as possible. We also realized, as progress was made along this line, that each individual unit taken off the tractor should have some ground supporting means carried on the frame of the implement and quickly dropped to the ground before the implement was detached from the tractor, in order to support the implement in its proper position for quick reattachment.

The real problem was to provide in the redesigned machines sufficient strength to compensate for the removal of various braces which had formerly been employed and attached to different parts of the tractor.

Since in many kinds of work the drawbar must be removed, it was plain that in order to speed up the work

of attaching the machines means would also have to be provided for speeding up the removal of the drawbar. In some instances, where the drawbar is no objection while the implement is used, we have provided means for leaving it in its usable position.

We solved our quick-on and quick-off problem by employing the hinged bolt idea that we had used at the front end of cultivators for a great many years. The two upper bolts drop into slots in the quick-attachable brackets on the implement or the drawbar and the lower bolts are readily lifted into place through a keyhole-shaped slot in the bracket. The nuts are never removed from these bolts and to fasten the machine it is only necessary to turn these nuts tight. To detach, the nuts are run back, but are prevented from coming off the bolt by means of cotters.

After this problem was well under way we set as a goal a complete line of machines which could be attached or detached without removing or inserting a single bolt or nut. This goal was finally achieved, although in manufacture a few slight modifications were made in one or two instances which would require the removal or insertion of two bolts, with slight loss in the facility of attaching.

We naturally felt we had made real progress when we put into use this hinged bolt and slot idea of attaching all of our different machines. However, loosening and tightening the nuts on these bolts with an ordinary wrench took time which was relatively long as compared with that required to get the machine into place. To speed up this operation we provided a 4-ft socket speed wrench which permits the operator to stand in front of, or behind, the implement and reach through and in between various parts of the implement to get at the nuts on the hinged bolts.

All of the implements for direct attachment to the small Farmall are now of this type, and the design is being carried into the machines of the two larger models. It may be interesting to note that once we had worked out the fundamentals of this problem, we found it much easier to design new implements with a common base. This base is our quick-off and quick-on method of attachment.

The foregoing is a very brief sketch of the basic problems with which we were confronted. However, there were several complications which should be mentioned.

At the time the program was started there were thousands of tractors already in the hands of farmers. Obviously it would be highly desirable, especially from the standpoint of such owners, if we could devise a method of attachment which could be applicable to tractors already in use, as well as those of current production. To accomplish this meant that no appreciable change in the construction of the tractor would be permissible, or at least that any change which might be made must be such as could be incorporated in tractors which had been sold, without much trouble or expense. As it turned out, we were able to avoid any change whatever in the tractor.

Also, since any machine is used only a few weeks during the season, while the tractor will be used over a period of several months, it is reasonable to expect that the implements will in many cases outlast the tractor. Again, from a farmer's standpoint, it would be highly desirable to have the machines fit any new models of tractors which might be brought out from time to time. Since this meant that future tractor models would have to be limited with respect to certain basic dimensions, and also that the machines for attachment would have to maintain similar basic dimensions, naturally it was important to keep the number of such basic dimensions at a minimum, to give as much latitude as possible for changes in the design of the tractor as improvements were made.

I have not said anything about the quick-detachable feature on the power take-off shaft, as that is not involved with most of the direct-mounted machines. It is involved, however, in some cases, and I may say that the means elected as being most satisfactory from all angles was a spring-actuated sliding member on the shaft which slipped over the splined end of the power take-off shaft on the tractor. The sliding member is simply pulled back against the large coil spring and placed over the end of the splined shaft. The spring pushes it home and holds it in this position. It may be disconnected by simply pulling the sliding member off of the splined shaft, and in some instances, where spring trip means are employed to prevent damage to mowers, etc., the power shaft is disconnected automatically from the take-off shaft by this means.

### Contribution by G. D. Jones

THE TRACTOR industry has developed, and is developing, mobile power units that will give specified drawbar pull, and pulley and power take-off horsepower, with little or no thought to the implement that is to be used with the tractor. When we realize that the tractor is only a means to an end and that the work accomplished is done through the implement, whether it be soil working or harvesting, it seems apparent that the primary design and development should coordinate both the power unit and the implement, thereby producing the two units whereby the most efficient results can be obtained.

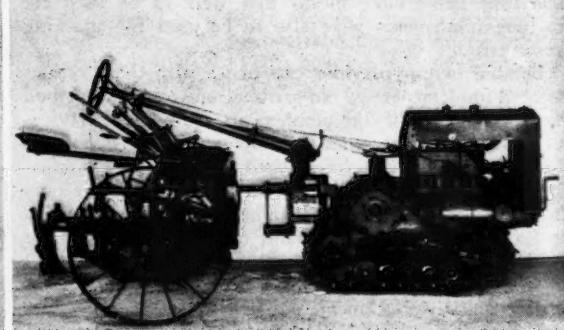
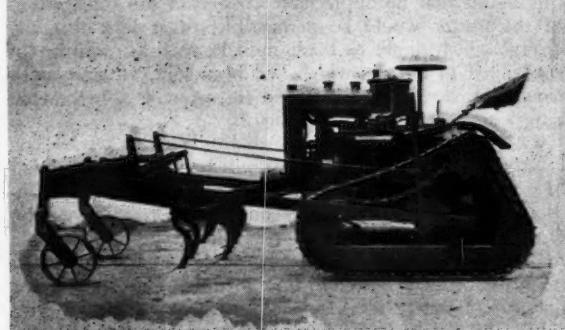
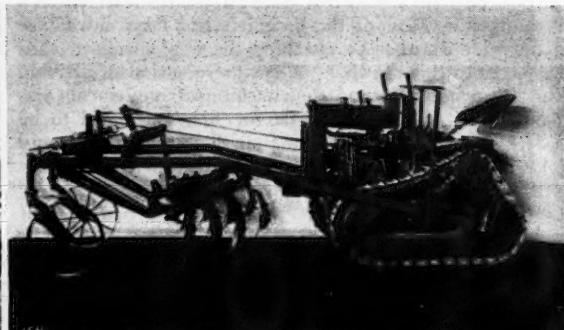
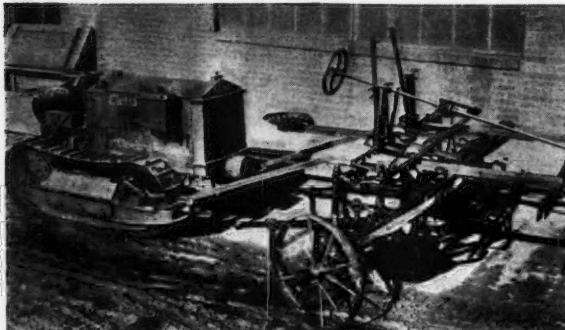
Author: Agricultural engineer, Cleveland Tractor Company. Mem. ASAE.

Early in the intensive development of the tractor industry, around 1917 to 1920, there were two schools of thought. One was that of incorporating the implement into the power unit, such as the early cultivating machine which included the cultivator and the engine for driving the same all in one unit. It was of no value other than for the specified work for which it was designed. Large tractors, some of them requiring small step-ladders to mount the cab, were used to pull plows and harrows, doing the job of general soil preparation work, and pulling large combines. Some of the smaller tractors were used to pull grain binders and mowers.

In the year 1918, at The Cleveland Tractor Company we started developing an all-purpose tractor, one that not only would do the rootbed preparation, but also the cultivating and harvesting. This was the other school of thought, and the accompanying illustrations give a more graphic idea of our development in this direction than can mere words.

Three or four years after this development, the trend was toward a general-purpose tractor, and numerous manufacturers brought out tractors having mounted thereon cultivators which were attachable and removable. The attachment and detachment feature, however, was rather a cumbersome affair requiring anywhere from four to ten hours to put on or take it off the implement. Gradually this development has been refined and today we find several units that can be put onto the tractor or taken away from it in only a short period of time.

Personally, I am not satisfied with this trend. I believe the most important factor is that, apparently, our engineering departments are divided, and I think this is true



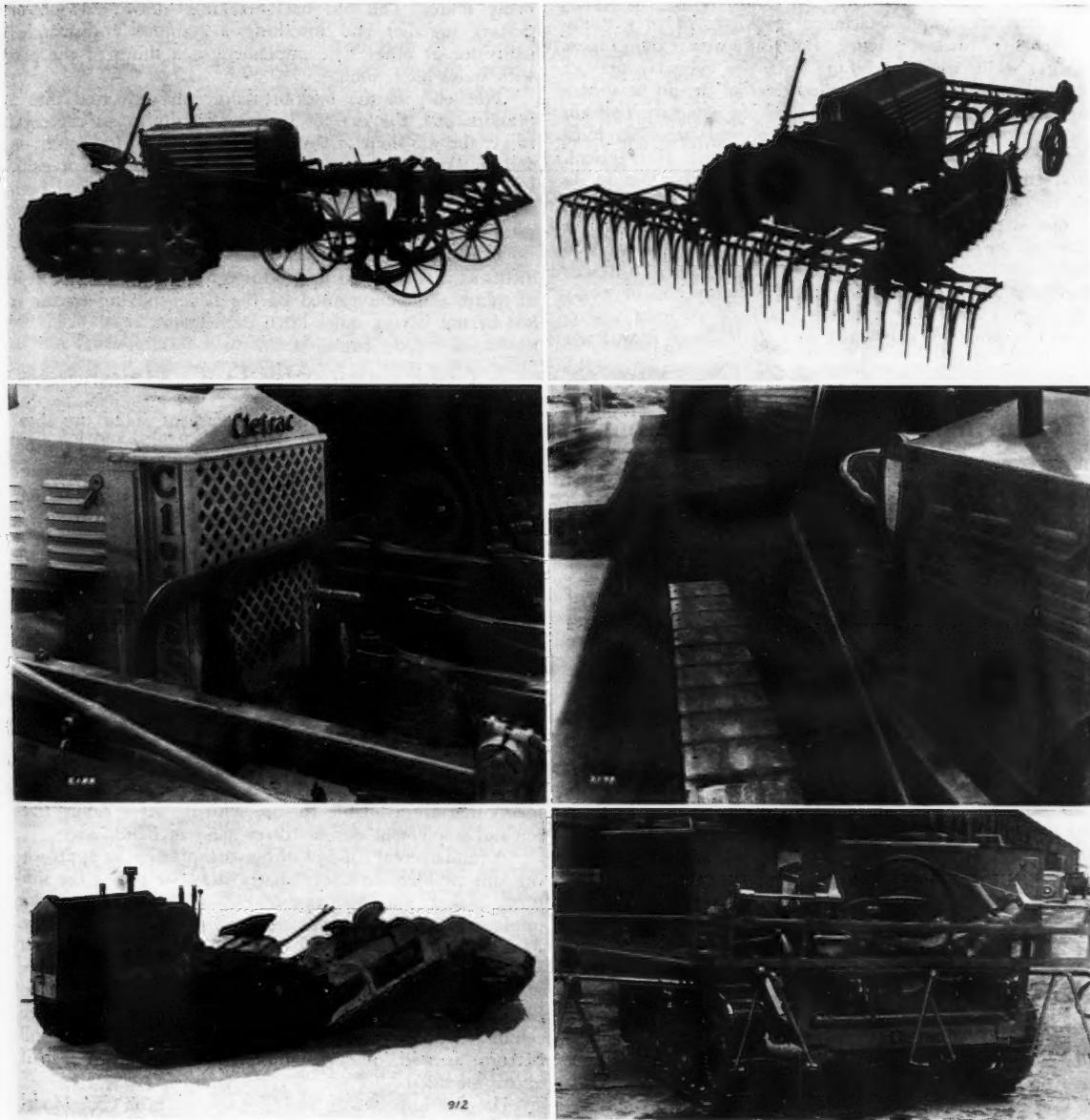
#### PROGRESS IN THE DEVELOPMENT OF QUICK-ON AND QUICK-OFF CULTIVATORS

(Upper Left) A first attempt (1918) to develop a push-type cultivator. This is a conventional horse-drawn cultivator adapted and attached to the front of the tractor frame. (Upper Right) An early push-type cultivator providing accurate control of depth from the driver's seat. (Lower Left) A push cultivator with shovels mounted on a single bar. (Lower Right) A tractor-drawn cultivator providing for operation and control from the implement and either low or high hook-up.

in practically every one of the implement concerns. They have the tractor division. Its function is to develop a high-efficiency, long-life tractor unit. They have the implement division, separate and distinct from the tractor division, in which the designers are endeavoring to perfect an implement, sometimes, of course, along the old traditional lines, but nevertheless attempting to develop an efficient and sturdy unit. After this development is brought along, they try to fit it to the tractor. In this fitting of the implement to the tractor there has been no real tie-in. The implement designer has to use what the tractor designer decides is

best to produce an efficient tractor. It appears to me that the thing we have to do, ultimately, is to develop the tractor and the implement, keeping in mind the whole picture of what the tractor is supposed to do, and that the tractor is only a dirigible, mobile power unit that must function with either a soil-working unit or a harvesting implement.

What of the future trend? I believe it is an agricultural engineering problem, and not an automotive problem, or an implement problem. This is where the agricultural engineer should function, and here is where we can put into effect the statement and plea of C. O. Reed, "Do not



QUICK-ON AND QUICK-OFF FEATURES FOR VARIOUS IMPLEMENTS

(Upper Left) Modern push cultivator with gangs removed and planter installed in carrying frame. (Upper Right) Cultivator at front and weeder at rear of tractor for dual operation. (Center Left) Attachment means for permitting vertical movement of cultivator gangs, while restricting lateral movement. (Center Right) Push arms mounted in bell housing carried by the tractor. (Lower Left) A two-row potato digger mounted on caster wheels and attached to tractor with vertical pivot only. (Lower Right) Complete sprayer equipment easily mounted on and detached from tractor

carry engineering to agriculture. . . . when we work from the inside of agriculture outward, instead of attempting to work into it from the outside, we are amazed at the opportunities offered by the needs of the natural science for engineering interpretations of the fundamental engineering involved." Truly golden words of wisdom. The agricultural engineer is the man who should be able to combine these two problems into one. I am firmly convinced that the future implement and means for operating it will go through a rapid revolutionary stage, and that we will carry out all of the work of fitting the rootbed, treating the soil chemically and physically, and seeding, or planting, in one operation. Of course, there are some things to watch, even attachment and detachment problems of present implements for present practice. But while we are doing these things; while we are working with the everyday practice of implement and tractor connections, we should be spending at least an equal amount of thinking about mechanisms for improved processes. These improved processes must deal with the biological engineering which is true agricultural engineering, for our problem is one that has to do strictly with plant growth. This plant growth originates in our soils, which are composed of elements that either function correctly or incorrectly as conditions arise, and these conditions are generally brought about through manipulation by man, rather than by nature. So in working on this extremely interesting subject we must understand our problem, and when once understood, it will not be difficult to solve.

### Contribution by Geo. H. Nystrom

THE MANY jobs the tractor must do and the need for the tractor in many locations to harvest, cultivate, and mow during the same period, resulted in the development of quick-on and quick-off implements.

Previously, the task of attaching or detaching the tractor cultivator consumed many hours, and often it required at least two men, well equipped with special wrenches and tools.

Today, with the quick-hitch cultivator, it is merely the small task of driving into the cultivator or backing out, as the case may be, dropping in or taking out two pins, and hooking or unhooking one pin with cotter on the power lift, all of which requires no special tools or heavy lifting. Other implements such as mowers, sweep rakes, side rakes, listers, plows, and cotton bedders of the integral type are now just as easily hitched or unhitched.

Quickly hitched and unhitched implements are never dismantled. They are intact, completely erected, and remain so, always ready when needed, and put away in the implement shed much easier, for storage until needed again.

When the conventional type of tractor attachable implement is dismantled, it is usually thrown in a heap. The user may forget from one season to the next just how it was originally erected.

Furthermore, a heap of implement parts and bundles piled away for storage is too inviting to the user to rob them of their parts, or to take off bolts and nuts, should the user need these parts to mend some other machine. A completely erected implement, after it has been unhitched, is seldom disturbed and is always ready for quick use.

In most sections hay cutting comes on when the second corn cultivation is required. The user can change from the mower to cultivator, or vice versa, with ease and no loss

of time. He does both jobs with one tractor, eliminating the need of a team for one of the two jobs.

When grain is ripe, ready to cut, this crop has preference over all other crops. Just at this time corn needs tending, perhaps laying by, but is neglected if there is no other means of power available to cultivate as the harvest goes on.

With a quick-on and quick-off cultivator there are periods during the day, morning or evening, when the user can quickly get into the cultivator and do this important work along with the harvest.

This presents only a few of the advantages. There are many more. The old back-breaking, drawn-out job of putting together and installing a completely dismantled cultivator or other style implement is a thing of the past with quick-hitch tools.

Not only is the back-breaking job converted into a pleasant one, the ease of hitching results in an eagerness to get the job done at the right time. Then, too, quick-on and quick-off features mean more times through a cultivated field, a job that has dragged along and had been sadly neglected by those who found hitching to the cultivator tiresome and nearly an all-day job.

It is just as important to save time changing implements as it is to speed up tractor travel. If this is not kept in mind, the time gained by the faster-moving tractor is lost by not having quick-hitch implements.

### Contribution by D. C. Heitshu

THERE appears to be no argument about the absolute necessity of making tractor-mounted and tractor-operated implements so they can be readily and easily attached to or detached from the all-purpose tractor. Under any other scheme the all-purpose tractor becomes a "one-purpose" machine and the very idea that brought it into being is defeated. The discussion, therefore, deals with details of how it can be and is done in one specific case.

In looking back over the development of the all-purpose tractor and its tools, it is interesting to note how the industry has progressed through the "attachment" stage to the present "tractor-mounted" period. Very few people, even agricultural engineers outside of the implement manufacturing fraternity, realize the great amount of work that has been, and is being done on this single phase of the all-purpose tractor. Today it is a generally accepted fact that an all-purpose tractor is no better than the implements that are available for use with it. As a result, tractor and implement design travel hand in hand.

A fundamental concept of our organization in approaching this problem has been that a drawbar pin is the simplest, easiest, and best easy-on-easy-off method of tractor implement coupling wherever it can be used satisfactorily. This idea still holds true. In fact, a careful analysis of implement operation places all tractor implements, except planters, cultivators, and power mowers, in the drawbar-pin-hitch class. Furthermore, it will be found that even certain types of planting and cultivating equipment will perform as well, or even better, with a pin hitch than if tractor-mounted.

The first implements made for use with the Case Model CC all-purpose tractor were typical of predepression tractor implements. These implements were distinctly tractor attachments. They were bolted, braced and pinned so thoroughly that they became a definite part of the tractor when mounted. At that time it was a case of "setting up"

Author: Engineer, Allis-Chalmers Manufacturing Company.

Author: Engineering department, J. I. Case Co. Mem. ASAE.

the implement about the tractor to attach it, and then tearing it down to detach. When implements of this vintage were off the tractor they were in many pieces, and the misplacement and loss of parts between periods of use was often serious. However, the industry was so rushed to fill orders that little or nothing could be done about correcting this obvious weakness.

The depression brought a breathing spell, during which the engineers had time to correct and improve in an endeavor to incite buyer interest. Judging by the present acceptance of the all-purpose tractor and its implements, the engineers must have accomplished something of merit during that time.

This improvement of tractor-mounted implements, especially as related to the easy-on-easy-off feature, is a continuous process. Our company introduced its first motor-lift, easy-on-easy-off implement in 1931 and the program of development and improvement is still in progress. Much distance has been covered, but the ultimate goal is still far away on the horizon.

In developing our motor-lift implements with the easy-on-easy-off feature, a number of interesting conclusions were reached and incorporated in these machines. These conclusions, which are the basic principles about which this line of implements was built, are outlined here.

1 Each implement is to be a self-contained unit, or a limited number of subunits.

2 These units are to attach to the tractor at certain fixed points, these points to provide rugged and durable mounting with quick and easy attachment and detachment.

3 The power lift, fenders, drawbar, and other tractor parts are to be permanent parts of the tractor, having no dependence upon any implement in any position of rear wheel tread, or other adjustment of tractor or implement. It should be pointed out that this outline covers a full line of implements, and that this development has been on the full-line basis, not a specialized mounting for each implement.

With the basic specifications set up, the development work becomes a matter of routine. The methods used are unimportant, as only the final results are of material interest. For this reason the details will be left out and the three basic principles elaborated upon.

Building tractor-mounted implements as a unit helps the farmer to move or store these machines with the greatest possible ease when detached from the tractor. In the case of the cultivator, the most practical method has proven to be the use of subunits, as this makes far lighter assemblies which can be handled readily and stored in a minimum of space. In so far as is practical, these implement units have been designed to stand on their gage wheels, and other integral or supplied feet. This feature facilitates attaching to and detaching from the tractor.

Determination of the attaching points to be used was not a simple problem. Upon analysis of the draft, clearances, weight distribution, etc., involved in the various implements, it was decided to group the machine in two classes. The first group can best be described as the low draft requirement group. This includes the cultivators and certain of the planters. The second, or high draft requirement group, is made up of the listers, middle busters, buster planters, and similar implements.

The cultivators and light draft planters are attached by means of hinge clamps fitting in grooves about the rear axle housings. This attachment allows the implement to float about the rear axle on its own gage wheels, and to be lifted easily by the common lift bail. The attaching points are sufficiently far apart to provide excellent mounting and

control of the implement unit, even when the clamps are badly worn. Forward units of the cultivators are rigidly attached to the tractor body, for absolute control of the front gangs. This is accomplished by clamping the square tube used for mounting the cultivator gangs in a V-type mounting. Considerable field experience proved that an extremely firm front gang mounting is essential for satisfactory cultivator performance throughout the life of the machine. Unless this is provided, trouble results from wear in the mounting sockets, and/or in the gang-shifting joints. Also, whenever working on side hills and over terraces, the cultivator must be held firmly to its work by a rigid mounting and a fast, responsive steering gear.

In mounting the implements having a heavy draft load, it is necessary to change the mounting from that used on cultivators and other light implements in order that the tractor may perform satisfactorily with these heavy loads. The swinging drawbar is attached very close to the optimum position for the tractor to exert its maximum pull. For this reason it was decided to remove the swinging drawbar for these machines and attach the main draft member of the unit implement at this point. This draft member is braced by simple draft rods. From this draft member the beams of the implement extend rearwardly so that the implement proper is to the rear of the drive-wheels. In this position the implement is suspended between its own gage wheels and the main draft member. Since the draft member is between the front and rear wheels, this suspension provides fine depth regulation. The implement is lifted easily by the common lift bail mounted on the rear of the platform frame. Guide bars to prevent lateral shifting of the implement, and thereby provide better control, are usually mounted at the rear of the tractor. This design provides for simple and easy hitching of the implement. The tractor is backed to the machine, the hitch bar attached, the lift rods hooked in place, and the tractor and implement are ready for the field.

To provide permanent mounting of the various tractor parts involved nothing more than a series of compromises between the tractor and implement designs. The only tractor part which is removed for implement attaching at any time is the drawbar, and this only when the heavy-draft implements are used. On the majority of farms the drawbar is never removed from the tractor, but is immediately available upon removal of the implement.

There are slight modifications of this system in mounting certain machines. The main difference is made in the case of the power mower. This implement clamps firmly about the rear axle housings, in the grooves already mentioned and pilots in the drawbar guide angle. In addition to this mounting, brace rods are added to help withstand the vibration of the mower in operation. However, this mounting is simple and the rather common interchange of cultivator and mower is readily accomplished. The four-row, check-row planter with fertilizer attachment, as well as the fertilizer attachments for side dressing and other uses, are only slightly different in their mounting.

Implements designed for the smaller Model RC Tractor follow the same general principles of design, although the details are different. The major difference is that the larger tractor takes motor-lift implements exclusively, while the smaller tools on the Model RC are designed for single-lever hand lift.

As has been previously mentioned, the industry has made great strides in improving tractor implements for farm use, and without a doubt, the farmer in the future will be able to buy better, more convenient, more economical all-purpose tractor implements than he can today.

# Tractor Used as Grasshopper Catcher

By Frank M. Byers

**H**EAVY infestations of grasshoppers in soybeans, clover, and alfalfa fields, and in wheat and oat stubble during the summer and fall can be greatly reduced by the use of mechanical catchers, commonly known as hopper "dozers". Under good conditions about 75 per cent of the hoppers may be collected by operating a hopper "dozer" over the fields once.

Grasshoppers fly low, seldom more than 40 in from the ground, and many of them will not leave the ground more than 10 to 15 in. In order to catch them, therefore, the front edge of the catcher must be as close to the ground as construction will permit with the top of the pans not more than 8 in from the ground.

A rubber-tired tractor, which has a speed of 5 to 8 mph, is the best vehicle upon which to mount the grasshopper catcher, because the tractor can be handled better over rough fields and will do less damage to the crops over which it runs.

In the fall, it is advisable to use the catcher on any remaining grasshoppers, since these winter over and reproduce the infestation for the next season.

In using the catcher, it is advisable first to proceed along fence rows, the edge of a corn field, along ditches, or any cover in which the grasshoppers always seek to hide. It will be observed that to start at any distance from cover with the catcher always drives the hoppers in the direction of the cover, which should be avoided.

In cutting small grains and grasses, it is sometimes advisable to leave a strip around the sides of the field, especially next to corn fields and soybean fields, and in these strips the grasshoppers will remain for a time before they leave to go into the other crops. In these concentration strips the catcher can be used for several days in an effort to catch the hoppers before they go into neighboring fields. Sometimes it is well not to cut the last 20 or 30 ft in the center of the field, and to leave this for the

hoppers to feed on. This will give opportunity to destroy them before they leave for other fields.

The grasshopper catcher illustrated here is described in Circular 466 of the University of Illinois, Urbana. It is 40 in high, 9 ft wide. Three sheets of 24-gage sheet metal, 36 by 64 in, fastened together by rivets and solder and bent into the shape illustrated will make a catcher 9 ft wide. It is 18 in wide at the bottom. The bottom pan is 5 in deep and must be water-tight. The apron hanging down from the front edge is 6 in wide, and the edge of it must be rolled to prevent tearing the tops of soybeans or other vegetation over which it is run.

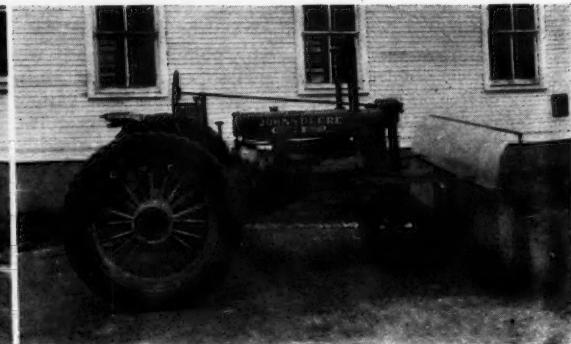
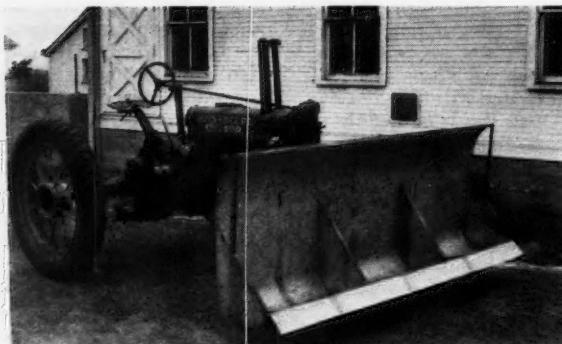
Horizontally across the back of the catcher are fastened two pieces of angle iron, 2 by 2 by 3/16 in. These angle irons are spaced about 15 in apart, which permits two vertical angle irons to be bolted on, which will have holes bored at frequent intervals for adjusting the up and down height of the catcher from the ground. These two vertical angle irons should be about 24 to 30 in long which will permit the catcher to be raised to the top of soybeans or other fields.

The cross partitions in this catcher were sawed out of 1 1/8-in soft wood. On the inside of the two end boards, it is necessary to solder in pieces of the galvanized iron about 8 in high to hold the water. Brace irons extend from the tractor to the outside ends of the catcher to strengthen and prevent vibration.

It would be possible to use 2x4 and 2x6 wood timbers in place of the angle irons.

In the pan of the catcher is carried 2 or 3 in of water with one quart of kerosene or distillate to kill the grasshoppers. When the pan becomes full of grasshoppers, it can be scooped out with a small scoop made of window-screen wire, and the solution will then drain back into the pans. These dead hoppers should not be thrown out for chickens or animals to eat.

Author: Manager, Midvale Guernsey Farm, Moline, Ill.



TWO VIEWS OF A GRASSHOPPER CATCHER FOR USE WITH A TRACTOR

# Technique in Mapping as Related to Land Use

## *As Developed for the Rio Grande Joint Investigation*

By Fred C. Scobey

BY THE TERMS of an agreement with the National Resources Committee entered into in 1936, the U. S. Bureau of Agricultural Engineering was charged with the two principal duties of ascertaining the consumptive use of water in the major divisions of Rio Grande Basin above Ft. Quitman, Texas, and mapping and tabulating the areas in agricultural crops and water-consuming native vegetation. Involved in the studies was a portion of Rio Grande's length totalling some 700 mi. A difference in altitudes of nearly 6,000 ft was also involved. So long a stretch and so wide a difference in elevations were marked by many variations of climate and soils and by wide differences in acreages and kinds of crops.

These complexities had their reflections in the mapping work—both field and office—causing the adoption of various methods far enough out of the ordinary to justify today a description of the whole job. There are doubtless many engineers in this group who have undertaken such work in the past, or may have to do it some future day. I am sure they will be interested in a recital of our problems and how we dealt with them.

The original plan for mapping the vegetative cover was much simpler than the plan finally adopted. Essentially, however, the initial purpose—that of ascertaining the areas of irrigated land and other land representative of vegetation "using appreciable quantities of water"—was retained. In the end it was decided to account, on a map, for 100 per cent of the area between the lower fringes of

the hills and bluffs along the main stem of Rio Grande through New Mexico and Texas, and to set such limits for the work in Colorado as would keep the map from including areas which could not meet the stipulation of "using appreciable quantities of water."

One object of this part of the Rio Grande study was to furnish an estimate of the total quantity of water completely removed from various parts of the stream basin during the season of 1936. This involved the determination of the consumptive use of the irrigated lands and towns and cities<sup>1</sup> actually given water; the consumptive use of "native vegetation"<sup>2</sup> not given water but taking it by virtue of access to the water table; and the evaporation from river and lake surfaces and moist beds. It was

<sup>1</sup>While not all "irrigated", town and city areas are users of water. Where definite information does not exist to indicate the use, it is customary to allow about the same amount of water for town and city areas as for equal areas of irrigated land.

<sup>2</sup>As the Rio Grande flows from its sources at elevations above 9,000 ft, through successive valleys by which it finally descends to 3,450 ft below El Paso, the character of the native vegetation undergoes marked changes. In the higher elevations the river is predominantly bordered with willows. San Luis Valley has little of the common sage brush, but its undeveloped areas are covered with rabbit brush, salt grass, chico brush, and the like. The extensive areas in this valley which were irrigated two or three decades ago but have since been idle show a denser growth of brush than adjoining virgin sod lands. Along the river cottonwoods appear with the willows. This type of river bottom vegetation holds through much of the Middle Valley in New Mexico. In the more southerly areas desert growths appear, notably the mesquite, a bean-bearing brush that sometimes assumes tree-growth stature; the tornillo, a thorny brush some 12 to 15 ft high; and the salt cedar or tamarisk, a tree-like growth with deep green bushy fronds. The term "bosque" is applied through New Mexico and Texas to the denser jungle growth along the river and in other places where water is within easy reach of the roots. It comprises the larger trees of cottonwood, a dense undergrowth, and sometimes an underlying swampy grass growth.

Presented before a meeting of the Pacific Coast Section of the American Society of Agricultural Engineers at Berkeley, Calif., February 5 and 6, 1937.

Author: Principal engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. Mem. ASAE.



(LEFT) THE TOWN IN THIS VIEW IS MANASSA. THE WHITE SPOTS ARE BARE LAND. (RIGHT) TYPICAL SLASHED UP IRRIGATED LAND IN THE MIDDLE RIO GRANDE CONSERVANCY DISTRICT, NEW MEXICO, SHOWING RAILROADS, ROADS, LIGHT LINES, AND CANALS

assumed that roadways and railroad grades use little more than nominal quantities of water; a small allowance was set up for such lands to represent evaporation losses.

The following list of classes of vegetative and other areas was finally adopted for mapping:

- 1 Cotton
- 2 Alfalfa and clover hay
- 3 Native grass cut for hay
- 4 Irrigated pasture
- 5 Early season annual crops (field peas, small grains)
- 6 Late season annual crops (corn, sorghums, silage fodder, sugar beets, potatoes)
- 7 Miscellaneous (orchard, vineyard, tobacco, beans, onions, melons, chili peppers, garden truck)
- 8 Land normally irrigated but temporarily out in 1936 for various reasons
- 9 Areas in native vegetation using water in appreciable quantities and river bed or open water
- 9a Open grass
- 9b Brush
- 9c Trees (bosque)
- 9d Open-pooled water
- 9e River and canal surfaces and exposed beds
- 10 Double-cropped areas
- 11 Town and village areas
- 12 Areas once irrigated but not now (largely San Luis Valley)
- 13 Bare land.

The original plan to ascertain the irrigable land, both inside and outside the constructed irrigation systems, was revised to cover only those areas within the reach of the systems already constructed, and planned minor additions and extensions to them. This curtailment was decided upon in recognition of the fact that there could not be any great quantity of water available for extensions of the irrigation systems; that the arable land available would be many times greater than any gross area that could be regarded as feasibly irrigable. Thus the final stipulation holding the mapping of arable lands to the valley floor along Rio Grande in New Mexico and Texas, recognized that reclamation and irrigation of the dense growth of native vegetation areas merely changed the use of water from its natural non-beneficial use in large quantities to a beneficial use by irrigated crops in appreciably smaller net quantities. In other words, such extension of the irrigated areas as would displace water-loving native vegetation would not increase the use of water by those areas, but would, in fact, decrease it and make more water available for general purposes.

After the field mapping there remained the essential task of converting pictured type classifications into acreage and separating that acreage into summations, by counties, major canal systems, major tributary areas, and many other requested segregations.

*Plan of the Mapping.* The following technique was used in planning the field and office work.

Instrumental surveys were eliminated from consideration because of the time and expense they would involve. Inspection, supplemented by a minimum of road measurement and pacing appeared to be the only feasible course to follow. It was known that aerial maps existed for most of New Mexico and Texas, but only one or two relatively small areas in San Luis Valley had previously been mapped by airplane. First expectation was that other San Luis Valley maps could be used as bases, but this assumption was soon found to be infeasible as too much of the

Valley did not conform to the original theoretical townships and sections as they appeared on the General Land Office plats. Some of the first western sectionizing was done in San Luis Valley, under the contract system, and the lines on the ground did not agree with the plats. Even with a map showing approximate locations of canals, railroads and towns, and on which most farms appeared in fractional sections of land that might reasonably be assumed to conform to land survey lines, it was still evident that great difficulty would be found in mapping areas bordering on the meanders of the streams, with ragged edges on at least one side. This difficulty suggested the desirability of aerial photography extending far enough beyond the threads of the streams to show roads and other lands along squared-up fractions of sections, so that the whole local area could be tied in to the general map.

In the end most of the Valley was flown on the same basis as northern New Mexico, that is, with lineal flights up and down the Valley, north and south. These flights produced a series of contact<sup>3</sup> prints which could be assembled along the lines of flight and reduced or enlarged to approximate precision scale by photostatic process. This aerial mapping was done by a western aerial-photography organization, under contract with the U. S. Soil Conservation Service. The Service made the results available to the Bureau of Agricultural Engineering in accordance with the terms of the agreement between the two.

Since the mosaic sheets from this survey were not made available at once, it was necessary to rely upon the contact prints (scale of which as a rule was greater than 2 in per mi), and a coefficient of reduction had to be calculated for each flight-strip and sometimes for short portions of a strip. Pending receipt of contact prints, the field mapping proceeded with such base maps as could be developed. When the aerial sheets became available, the results of this field mapping were transferred to the aerial photostats.

*Field Parties.* Two men with one automobile made the most efficient mapping crew. The great distances to be covered in San Luis Valley with lack of suitable living accommodations there and in other portions of the area, resulted in high transportation costs. In congested areas, such as those above and below Albuquerque, both mappers left the car, each to map a given area; one or the other returned to move the car as agreed or as was convenient. In open country one man drove while the other mapped. When photostats of aerial maps were available one field after another could readily be identified. The mapping then consisted of coloring the fields so identified with soft pencils in accordance with a color scheme

<sup>3</sup>The same camera was used for the flights in Colorado and New Mexico. It has four separate units that take the four quadrants finally printed as a 10x10-in. photograph for each of the exposures comprising one of the series of pictures for a strip flight. The films are numbered consecutively and a print from one of them is called a "contact print" in this discussion. The "mosaic" print, as its name implies, is the final sheet, in units of 15 min of latitude and the same of longitude. This sheet is the integration of the best parts of each of the "contact prints", reduced to a common scale of approximately precision order. In time the mosaic lags behind the contact prints by several months. The contact prints used in the Rio Grande investigation were of varying scales, some large and some small, compared with the nominal scale of 2 in to the mile. Consecutive pictures in a "flight" can be joined for larger photostats, but pictures of adjoining flights could seldom be joined until reduced to a common denominator by means of enlargement or reduction by photostat. Mosaic sheets were available for the El Paso area and for much of the Middle Valley area, but the contact prints alone for the San Luis Valley, to the number of some 1100, became available only toward the end of the field work.

adopted for each larger locality; or, if more convenient, by inserting the appropriate classification numbers.

For New Mexico, much of the aerial mapping had been done the season before that of the field work. For the area below El Paso the flying had been done two years before. Even with this lapse, it was not difficult to identify the fields.

Where a language other than English is commonly spoken, as in many sections of the Rio Grande Valley, at least one man of a mapping party should speak it. One should be an engineer, with some training in land surveying or other practice that would familiarize him with land lines. It is also well for one of the men to have come from the section to be mapped. The mapping crews used in the Rio Grande investigation all consisted of or included young men so qualified.

In such work there is always automobile trouble with mud and sand. Two men can get a car out of such difficulties where one man could not. Likewise, in a population which may not understand the purposes of the investigation, the presence of more than one man may prevent trouble. Two can talk over debatable classifications on the ground and make well-considered decisions where otherwise it would be necessary to refer disputed questions to the party chief.

One chief can supervise the work of several field parties of two men each, his principal duties having to do with ascertaining land lines to place on aerial maps, obtaining local maps on which the geography may appear in intimate detail, checking with local authorities for identity of ditch names, road locations, etc. In brief, he puts the field maps into condition for final drafting.

*Use of Odometer.* The trip odometer of the ordinary "speedometer" assemblage reads to miles and tenths of a mile, but much more exact measurements were found possible through the medium of a simple device of celluloid covering the "trip" window and etched in 5 divisions over the tenth-mile dial, permitting distances to be read to hundredths of a mile. A typewritten conversion table was prepared to convert these readings directly into multiples of .52.8 ft. As the width of a pencil line is only slightly under this figure on a scale of two inches to the mile, it was ordinarily the smallest division used. For the San Luis Valley, meters were calibrated and checked occasionally by driving along measured stretches of highway paralleling railroad tangents.

*Mapping Boards.* For field use 15 by 18-in plyboards  $\frac{3}{16}$  in in thickness were found adequate to hold the maps and afford convenient backing. These were treated with shellac to prevent warping and then covered on one side with 0.015-in celluloid. A second sheet of the same celluloid, hinged to one of the long edges of the board, was provided with a window about 4 in in diameter cut eccentric to the center of the board. Through this opening, sections of the map could be exposed for coloring without subjecting the rest of it to dust, water, or undesired discolored.

*Field Delineation of Class Types.* Where the scale of the field map is the same as that of the finished drawing, the areas can be traced on the final linen map. For reasons discussed later, in much of the New Mexico work it was necessary to field-map on the scale of 4 in to the mile, but the final drawing was on the 2-in scale. The necessary reduction was effected by tracing the field maps on linen, in rough outline, with the appropriate classification number in each type-block. The resulting sketch was then reduced one-half by photostating. For such reduction it was

found best to have the edge of the type-block clearly outlined in black ink.

In the case of the maps of San Luis Valley, where squared-up sections were the rule, tracings of boundaries were not made on linen but directly on celluloid of 0.010 in thickness. This tracing was made with a sharp steel point which scratched a mark deep enough so that the celluloid could be broken along the traced line. The steel point was applied at an acute angle and few or no shavings were removed from the etched lines.

*Determination of Areas.* The fragments broken out of the celluloid sheets along the boundaries traced with the steel point were carefully weighed to ascertain areas. The usual process in determination of irregular areas from scaled depiction on field maps has been by means of the planimeter. This device could not be used in the Rio Grande mapping. Many of the New Mexico areas were units of 3 to 10 acres, with great irregularity of shape and no relationship to section lines. Use of the planimeter permits no direct check on office accuracy. On the other hand, the weighing of the celluloid areas had many points in its favor, an important one being that until near the close of the field work, one office man, operating the weighing balances, was able to keep up with the field parties.

The Rio Grande Joint Investigation was not concerned with the area of any particular block of land. The field sheets might show, say, 50 or more tracts of alfalfa. The total area of the alfalfa on the whole field sheet was the item desired. This fact alone was enough to warrant discarding the planimeter process, which measures one area at a time. In final practice, a test-block template was carefully computed and cut from heavy celluloid (0.015 in thick). This template represented exactly 1,000 acres on a scale of 2 in to the mile and 250 acres on a scale of 4 in to the mile. Using this template, a test block was cut as a criterion for each field-sheet weighing.

In office practice, two methods were used. For the irregularly shaped areas in Texas and New Mexico it was found that the celluloid did not break out readily after being scratched. In handling such an area, the sheet of tracing linen mentioned above, showing the borders and appropriate classification numbers of the various type blocks, was held firmly between two thicknesses of celluloid of 0.0075 in thickness. Small wire-stapling machines set definite ties every inch or less around the edges of the sheets. The whole combination of celluloid and tracing linen was then weighed on a precise chain-type balance, the vernier of which read to one-tenth milligram. This reading represented a small fraction of an acre on the standard scale of 2 in to the mile; thus it was determined that the vernier need not be read, as the acre was the smallest unit desired. When the sheets of celluloid and linen were cut up, it was found that the sum of these parts was nearly always slightly less than the weight of the whole block. Apparently this small difference was caused by losses of weight in the celluloid as more edges were exposed to evaporation in the cutting process. Agreement within one part in 1,000 was considered as checking the weights of each class-type and the arithmetic of addition.

A celluloid sheet might contain several hundred separate areas in the type-classification. As the sheets were cut up, the two opposite pieces of celluloid for each area were dropped into an appropriately numbered cup, and the corresponding pieces of tracing linen were deposited in a small envelope. When the mapped part of the whole sheet had been distributed among the cups, the test block was cut from a remaining part of the sheet and weighed. This weight was noted on a paper near the previously recorded



(LEFT) TYPICAL OLD MEXICAN IRRIGATION LAND IN SAN LUIS VALLEY. (RIGHT) TYPICAL VIEW SHOWING NEED OF AERIAL MAPS IN DETERMINING LOCATION OF FIELD ALONG THE RIO GRANDE

weight of the whole block and became the criterion for determining the total areas for the various class-types, by direct proportion. On the same sheet, opposite the numbers of the class-types, the weights of all the small blocks of each type were listed. Their total was then placed under the weight of the test block. Finally, the scraps of celluloid and tracing cloth, plus the weight of the small pieces of tracing cloth which had been placed in the envelope were weighed together and listed. Obviously the sum of the weights of the various parts should conform reasonably closely to the weight of the whole assembly before cutting commenced. In case agreement of total weights was not close, the class-types were re-weighed until the error was found.

Long-handled manicure scissors with short, sturdy, curved blades were used in cutting the celluloid and linen. The balance was adjusted each morning. Cups of equalized weights were placed, one for each, on the sides of the chain balance. The left-hand cup was used to hold the small bits of celluloid, or even the whole sheet, rolled up and held by a rubber band while being weighed. By holding the right-hand cup from above, the pan itself was left free to accommodate the brass weights belonging to the outfit.

When the celluloid was etched direct instead of being used with a tracing, the process was quite similar. As each area was outlined its class number was scratched on it. As in the other method, the sharp point was directed at an acute angle to prevent shavings from being cut from the celluloid. However, insignificant error would result if shavings were made, as was ascertained by test.

*Office Tabulation.* The preliminary summing up of the various field sheets into the larger desired units, required 60 columns for any field sheet involving all the class-types. The final tabulations of course omitted the weight and other computation columns, and combined the field-sheet areas into canal, stream, county, or other desired summations.

All computations entering into the tabulations were made by 20-in slide rule and checked by different computers. All entries on the books were read against the

original notes. All additions were checked by making the horizontal totals equal the vertical totals. In converting the celluloid weights to acreages, the map coefficient was applied to the weight of the test block. Thus, if a test block of 1,000 acres on true scale weighed 2,000 grams and the field map were too large, so having a coefficient of, say, 1.100, then the equivalent weight of a 1,000-acre test block for that map would be  $1.1 \times 2,000$  grams, or 2,200 grams.

*Deductions for Roads, Railroads, Canals etc.* It was appreciated that all of any irrigated land area is not actually in crop, although to all appearances wholly comprised of irrigated lands, so 3 per cent was deducted from the gross areas of irrigated lands mapped. This deduction was also operated through the test-block weighing. Finally, there were developed three columns of "equivalent weight" of test block. The first was without deduction and was applied to areas of Rio Grande and other streambeds, and pooled water. The second column was developed for one per cent deduction and applied to areas of grass, brush and trees. This deduction was taken as representing bare lands on roads, highways and railroad beds. The third column was computed for 3 per cent deductions and applied to the irrigated areas on each field sheet.

Irrigated land is pictured on the map as nearly as possible to true scale but was tabulated on the basis of net acreage, or 97 per cent of the gross area mapped, the other 3 per cent being computed by slide rule to the nearest number divisible by 6 and restored to the tabulation as follows:  $1/6$  to Water areas;  $1/2$  to Bare Land areas, and  $1/3$  to Grass areas. The Water areas restoration was assumed to represent the water surfaces of irrigation and drainage channels; the Bare Land restoration as the traveled strip of roads, railroad roadbed, farm lanes and other bare areas that consume small amounts of water, such as evaporation after precipitation in areas of high water table. The Grass areas restoration accounted for the wide strips of grass along all roads, between the traveled strip and the fences confining the fields; and the similar strips along railroad tracks, between the roadbed and the

right-of-way fence; also, the banks and berms of irrigation and drainage channels.

Native vegetation was also tabulated for net areas, one per cent being deducted for *Bare Land* in terms of roads, lanes, and railroad beds and restored to the total in the *Bare Land* classification. No deduction nor restoration was made for the *Water* areas. The deductions and restorations were uniformly applied throughout the basin.

An appraisal of the results of the mapping leads to the conclusion that, in the case of the Rio Grande project, which has an excessive number of drains and canals, the 3 per cent deduction should have been increased—perhaps doubled. At the other extreme, the 3 per cent deduction was undoubtedly too large for San Luis Valley. It is considered to have been about right for areas along the main stem of Rio Grande in Middle Valley, though too large for the interior valleys.

However, since the Bureau of Agricultural Engineering was instructed to apply a percentage deduction uniformly throughout the Basin, 3 per cent is considered about as fair a proportion as could have been selected.

*Office Drafting.* The office drafting of final maps was based on precise plating of railroad notes where these were available and warping of the photostats from aerial mosaics to conform to the railroad lines. However, the conformity between the two necessitated little such adjustment. For the San Luis Valley map the primary skeleton was developed from the cross of railroad lines centering at Alamosa, the notes being made available to the Bureau by Arthur Ridgeway, chief engineer of the Denver and Rio Grande Western Railway. The base map had been built up from this precise cross supplemented by an automobile cruise with the odometer equipped to read to hundredths of a mile. This cruise was held in the main to long straight stretches of road leading out from some railroad crossing. The odometer was carefully read while the auto stood on the railroad tracks. Each road crossing, indicative of a section line was read and recorded on a rough-draft map. The cumulative distances only were read; thus any error was distributed throughout the cruise. Some thousand miles of such road work in the Valley supplementing the railroad lines provided a base map that served its purpose until detail subdivision within townships could be ascertained from the aerial maps available when the field work was being finished. The field parties found many areas of irrigated land that could not be tied into the map definitely until the aerial views quickly located them in proper position.

When plating the railroad notes all crossings of civil and political boundaries were noted and platted. These consisted of section lines (where existent), principal meridian, land grant and county lines, and in some cases Indian pueblo grant lines. It was found that such crossings did not always agree with their purported locations as shown on other maps. Wherever possible these discrepancies were reconciled, but where that could not be done, the lines were shown according to what appeared the best authority available at the time of the drafting.

The most important of the lines which may show marked discrepancies is the boundary between Colorado and New Mexico. There have been two or three surveys of this line and a line is now being set that purports to conform to the earliest survey, markers of which had been destroyed in a subsequent survey not upheld in the courts. Thus, General Land Office, U. S. Forest Service, railroad and county maps, while all appearing to be authoritative, do not all agree by nearly half a mile in the location of

this important line. The line shown on the Bureau of Agricultural Engineering map is one recently set under instructions of the Supreme Court of the United States and purports to restore the Darling Survey line run in 1857.

Aerial maps show topography only and not land lines. Hence, for most of the areas on tributaries of Rio Grande there was little upon which to base a definite location of Land Office land-lines. The best that could be done was to make comparison between mosaics and General Land Office official plats and locate the land-lines approximately, by scaling from stream intersections, mountain formations, and the like.

The many small valleys located on the tributaries of Rio Grande were grouped on the maps, to conform diagrammatically rather than to show their actual relationship to each other. This resulted in great saving in extent and cost of maps. Likewise, for these mountain valleys, a typical crop-classification was symbolized for one unit only in a group, but percentage-classifications were shown for that unit and for the other units as well. However, in the detailed tabulation the type-classification was given for each of the major local valleys.

The office drafting for the final maps in the Middle Valley areas was based on the alignment notes of the A. T. and S. F. Railroad from the mouth of the Galisteo above San Domingo to San Marcial, and the similar notes of the D. and R. G. W. Railway from Embudo to Buckman. For further detail the photostats of the aerial surveys were slipped under the tracing cloth and the railroad lines appearing on them were made to conform to the precision-platting shown by the official notes. In other areas, any definitely indicated base line was used in making corrections, as the photostats from the mosaics or contact prints could seldom be made to a precision scale. However, it was found that photostats made from the mosaics with the photographic apparatus set with a coefficient of 1.01 resulted in a print quite close to a ratio of 1.00, the 1 per cent allowance taking care of the shrinkage in the paper as nearly as could be anticipated.

Two sets of photostats were made from the mosaics for much of the Middle Valley, one at a scale of 4 in to the mile for field plating, and the second at 2 in to the mile for final drafting. In order to secure a work sheet of the field designations of crop classes, the field map was traced on linen. This tracing was later stapled between two sheets of celluloid and the types were cut out and weighed to determine their areas. Before being cut apart, the tracings were reduced by photostat to the scale of 2 in to the mile as nearly as could be computed and actually done, considering the inevitable shrinkage of the paper. At this photostatic stage the smallest of the local areas were bunched to form a block of such size that a type-symbol could be inserted in the drawing; that is, several fields of different crops were lumped in a "Miscellaneous" class.

Many problems arose in the field mapping which had to be solved individually and according to the best judgment of the mappers. The recital of these cases and how they were handled would undoubtedly interest this group, but would be too long for inclusion in this paper.

By way of summary, with a small force we mapped nearly 2,100,000 acres, of which about 925,000 acres were irrigated; the remainder, native vegetation and miscellaneous areas using water "in appreciable quantities." From the beginning of the field work to the conclusion of the office drafting, about 14 months will be the duration of the job.

# Contour Furrows Simplified

By Edgar V. Collins and Merle W. Bloom

**T**HE objective sought in designing and building the experimental machine described here was to provide a comparatively simple means of building contour ridges in sodded pastures without destroying any of the sod and leaving a minimum of unsodded earth exposed.

Right and left furrow slices are cut and lifted as shown in the accompanying diagram, but are not broken away at the outer edges. This is a very important feature as it insures uniform work and avoids skips and bunching in the finished work.

The right-hand blade cuts 4 in deeper than the left. A moldboard or turning plow following the left blade and working underneath the lifted furrow slice cuts 4 in deeper than the left blade and throws its furrow slice under the right-hand sod strip. This supports the right-hand sod strip at a sharp angle and permits the left sod strip to fall into a position about 3 in lower than its original position. Rollers are provided to press down the loosened sod strips. This is to insure a good contact with the soil underneath so the grass will continue to grow. Also, the roller smooths up the ridge and leaves it at a very uniform height.

The machine was used this past spring on a number

Journal Paper No. J463 of the Iowa Agricultural Experiment Station, Ames, Iowa, Project 542. Approved by the Iowa Station and the U. S. Soil Conservation Service for first publication in *AGRICULTURAL ENGINEERING*.

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TABLE SHOWING APPLICATION OF CONTOUR FURROWS

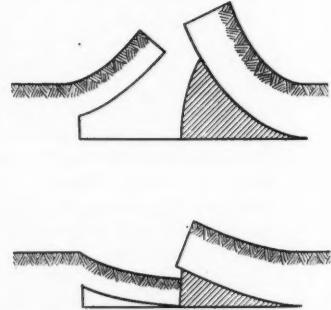
| Slope, per cent | Cu ft of water retained per ft of furrow | Spacing required to retain various total rainfalls |                        |                       |                        |                       |                        |
|-----------------|--|--|------------------------|-----------------------|------------------------|-----------------------|------------------------|
|                 |  | Vertical interval, ft                              | Horizontal spacing, ft | Vertical interval, ft | Horizontal spacing, ft | Vertical interval, ft | Horizontal spacing, ft |
| 1               | 7.0                                      | 1.0  | 100                    | 0.7                   | 72                     | 0.5                   | 55                     |
| 2               | 4.0                                      | 1.0  | 49                     | 0.7                   | 36                     | 0.5                   | 26                     |
| 3               | 3.1                                      | 1.2  | 39                     | 0.8                   | 28                     | 0.6                   | 20                     |
| 4               | 2.7                                      | 1.2  | 32                     | 0.9                   | 22                     | 0.6                   | 16                     |
| 5               | 2.2                                      | 1.3  | 27                     | 0.9                   | 18                     | 0.6                   | 13                     |
| 6               | 2.0                                      | 1.4  | 23                     | 0.9                   | 14                     | 0.6                   | 10                     |
| 7               | 1.8                                      | 1.4  | 20                     | 0.9                   | 12                     | 0.6                   | 9                      |
| 8               | 1.5                                      | 1.4  | 18                     | 0.9                   | 11                     | 0.6                   | 8                      |
| 9               | 1.4                                      | 1.4  | 16                     | 0.9                   | 10                     | 0.6                   | 7                      |
| 10              | 1.2                                      | 1.4  | 14                     | 0.9                   | 9                      | 0.6                   | 6                      |
| 11              | 1.0                                      | 1.4  | 13                     | 0.9                   | 8                      | 0.6                   | 6                      |
| 12              | 0.9                                      | 1.4  | 12                     | 0.9                   | 7                      | 0.6                   | 5                      |

NOTE: The table is based on noninfiltration.

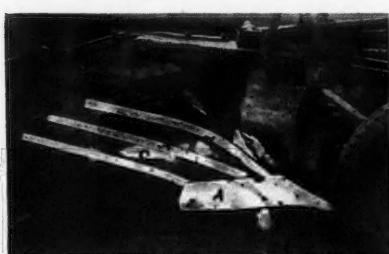
of farms on the Indian Creek Watershed near Marion, Iowa, and on farms near Eldora, Maquoketa, and McGregor as a part of the U. S. Soil Conservation Service demonstration program. The first work was done on slopes up to 10 per cent. The lines for the furrows were level contours with an average of 1.2-ft vertical interval. This gave a spacing of 15 to 20 ft between furrows. Some of the later work was on slopes as steep as 18 per cent. The table of water-holding capacity is based on cross sections of the completed work for the various slopes. The power required varied largely with soil and slopes encountered, but it appears that a track type tractor with about 20 hp at the drawbar is best adapted. Some of the work was done with a 10-20 hp tractor, but under other conditions the power of a 15-30 hp wheel tractor proved inadequate. The effective height of the ridge above the depressed sod strip averaged about 9 in after it was rolled down.

The contour furrows made by the machine have not been in use long enough to determine the effectiveness of such treatment in soil and water conservation, but it is anticipated that it will reduce run-off, insure an increased grass growth and make more practical the application of lime and fertilizers to pastures, as the ridges formed should prevent the loss of these materials by surface run-off.

Farmers have objected to the terracing of pastures, as the treatment destroys so much of the sod. The use of this equipment avoids that objection.



THIS CROSS-SECTIONAL DIAGRAM ILLUSTRATES THE WORK OF THE CONTOUR FURROWING MACHINE



(LEFT) SIDEVIEW OF CONTOUR FURROWING MACHINE SHOWING (A) RIGHT-HAND SHARE, (B) LEFT-HAND SHARE, AND (C) PLOW CUTTING 4 IN LOWER THAN B AND THROWING SOIL UNDER FURROW SLICE CUT BY A. (CENTER) CONTOUR FURROWING MACHINE IN ACTION, AND (RIGHT) THE FINISHED PRODUCT

# Engineering the Household

By P. B. Potter

**H**OUSEHOLD engineering is an important application of engineering, and agricultural engineers are the logical ones to make that application. The ever-increasing use of mechanical equipment in the home and the need for efficiency in household operations have brought engineering there, the same as engineering has been brought to every other field which of necessity has been compelled to become efficient.

Most of the progress in household engineering has been made by manufacturers motivated by profit from the sale of devices the housewife could use and would buy. However, progress has also been made by engineers in planning and arranging the rooms of the house, particularly the kitchen. Home improvement specialists and extension agricultural engineers have educated housewives (a portion of them, at least) to the necessity of having these improvements in the home. A great amount of propaganda and advertising is now filling the pages of the home magazines urging the homeowner and housewife to buy these things, mainly pieces of equipment that are expensive and probably beyond the means of most households. The housewife has caught the urge to have these things, but she is bewildered by the extravagant claims for them, by their high cost, and by a confusion of mind as to what she should have. She is now coming back at the propagandists for reliable information that will guide her in selecting, buying, and using this array of equipment. She wants to know why it is so expensive, exactly how it will perform, and how it will fit into her own particular household routine.

Reliable information of this kind must be supplied. I have just recently been in touch with three separate agencies in the extension field and all express the great need for unbiased and dependable information on household equipment and improvements. One girl in the field, who is very well trained and experienced in home equipment, writes "I find the women everywhere just hungry for information that will guide them in the selection and use of equipment. We need simple and reliable bulletins on anything and everything." In my own experience it seems that every family in town has asked me what refrigerator to buy, or what electric range, and if there is any way to get them cheaper.

If this kind of dependable information is to be supplied, engineers must have a hand in producing it. Merely using the equipment by home economists, as the housewife would do, will not suffice. Engineering studies must accompany all other studies if the information is to be correct and complete. But the home economists are not waiting for the engineers. This very day, in Kansas City, a home equipment committee sponsored by the U. S. Bureau of Home Economics goes into a three-day session to attempt to decide just what can be done toward producing the facts and information spoken of. To be sure engineers have been invited to join in the work of this committee, but where are some who are interested? It is an important

work and the women are going ahead with it, but I am certain that they must eventually have the help of engineers.

In urging and recommending that agricultural engineers wake up and take a hand, I am not overlooking the great work that the rural electrification engineers have done toward improving the status of the farm home by bringing electrical energy there, nor the work of the farm building engineers who have planned and arranged the house for convenience and efficiency, nor the efforts of the extension specialists who have educated country folks to the need of these improvements, nor even the accomplishments of the manufacturers who have developed and made available the equipment. All have been in the business of engineering the household. But it has not been known as such. Departments of agricultural engineering do not have a division of work called household engineering. Several home economics departments have divisions of home equipment, but there is little engineering to it. Household engineering is recognized as a distinct endeavor by the Bureau of Home Economics and the Office of Experiment Stations in Washington. They claim it as a definite phase of home economics and are clamoring for more and more efforts in that field. They give us every compliment and encouragement on the work we have done in household engineering at Virginia. I know they want more engineers to take it up. It seems to me that agricultural engineering departments should wake up to the important opportunities for service by establishing organized work in this field. Extension activities are developing, but I believe the greatest need is in research.

Household engineering work is highly cooperative. It cannot be done by the engineer alone nor by the home economist alone. Complete and dependable results will depend upon their working together. There is some complexity to the situation. Take household equipment, for instance. It is designed and made by men for use by women. It has the aspect of having usefulness to the housewife in her home with mechanical operation. It is expensive and must give satisfaction. The home economist can use the equipment and judge its utility and its satisfactory performance, but she can do little about its mechanical operation, its efficiency, or its cost. The engineer can determine these, but his results will mean little unless the home economist approves of the performance. There must be first of all the engineering viewpoint, and then there must be the home economics viewpoint. Since these two viewpoints are rarely found in a single person to an appreciable degree, it is necessary to find an engineer with an appreciation of the household; and it is also necessary to find an home economist with mechanical understanding. Let these two viewpoints work in harmonious effort, and worthwhile results will be produced. Either one working alone just cannot be completely successful. There is opportunity in the household engineering field for both. The field is not crowded; in fact, if I judge correctly, there is a great lack of talent of this kind. Few girls or women have sufficient mechanical ability and few engineers have a liking for household problems.

If I may speak of my own experience, I got into household engineering work because I happened to be a handy man. I could fix most any household appliance, and there

Presented before the Rural Electric Division at the annual meeting of the American Society of Agricultural Engineers at Urbana, Illinois, June 24, 1937.

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was plenty of fixing to be done fifteen years ago. Also I can get along with the women. As I began to work on household equipment problems, I found that there was something deeper than the mere testing of the performance of a piece of equipment. The performance had to be judged, not by revolutions per minute, kilowatt-hours, or degrees of temperature, but by utility and satisfaction in what was supposed to be accomplished. This called for the help of the home economist. Certain tests required baking and preparation of food materials which I couldn't do. Other tests required judging of results which I could only do approximately. So I got a girl home economics assistant whom I had trained in mechanics, physics, and electricity. She was a natural born cook, very patient and exacting, and turned out to be a dependable research worker. I believe we have done some worthwhile research in household engineering, and I wouldn't want to call it any less than that.

I should like to describe a few of the problems that we have worked on, in an attempt to show how interesting household engineering problems can be, and how necessary cooperative effort must be.

In our first problem on oven regulators we had discovered that the highly touted thermostats lacked a whole lot of doing what they were supposed to. Additional tests on other equipment showed the same thing—great ups and downs in the temperature curve of the oven, instead of the uniform temperature that the manufacturer would have the housewife believe she got. This was pretty poor performance from an engineering viewpoint, but it might still serve the needs of the housewife. To be sure of this we had to go back and determine just what temperature variations quality baked products would tolerate. This called for baking tests under many different temperatures and of several different products. Then along with the baking we had to have exact temperatures in the oven and correct operation. No known thermostat would give this, so the exact temperatures were obtained by constant watching of the pyrometer needle and manipulation of the main switch to the stove. By careful selection and preparation of ingredients and by following standard recipes, by using exact temperatures, and by critical judging of the products, we got the answer sought. Results showed that most baked products are satisfactory when baked in a temperature zone 50 deg wide, that is, 25 deg up or down from the optimum, except angel food cake which requires a zone only 25 deg wide. Biscuits were baked by the bushel, and pie crusts enough to fill a pantry. (Cakes were consumed as produced.) With this information about required temperatures, we were able to say that ovens did not give satisfactory temperature production and still do not, even in the late model electric ranges with improved thermostats.

Following the baking and regulator tests we got to wondering why electric energy in an oven had to be turned on and off, as is done by the thermostat, when other heat sources burn steadily at the right point. The kerosene burner is not turned on and off, nor the gas, but rather turned to the right point to give a steady temperature. Why not turn on a definite wattage in the oven and let it burn all through the baking period without any turning on and off? We got busy and fixed up an oven with three separate wattages either one of which could be turned on, or any combination of the three. Tests were run and the results exceeded all expectations. Temperature curves were produced which were straight horizontal lines with scarcely a variation, all that an engineer would ask for.

Then baking tests were run and the curves were still good, although somewhat lower. Developments are still going on and we believe we have a method of temperature control by definite wattage that will ultimately replace the thermostat. Our main difficulty has been to find the exact wattage required for a given oven and a combination that will produce the different required temperatures.

Another interesting problem was with electric irons. This started out to be just a series of tests to see what electric irons would do. After experimenting for a while and after watching the irons perform in actual ironing (the home economist doing the ironing), we discovered that the moisture content of the clothes being ironed had more than a little to do with the results obtained, both as to quality of the ironed product and the time and energy required. So this side problem of moisture content was run down, with very interesting determinations. Additional operating tests in actual ironings showed just what temperatures an iron must maintain to give satisfactory performance on different materials, and of course we learned just how the different irons and thermostats worked. Thus from a simple testing problem we determined the importance of moisture content and what it was, the optimum ironing temperatures, kilowatt-hours of energy required to iron a square yard of standard material, desirable features and wattage in an iron, as well as performance curves for all irons. Again an engineering problem turned out to be a home economics problem as well.

A short study of electric refrigerators gave some interesting information. We set out to determine what action frost had on the performance of the unit. A previous study had reported that frost on the unit added considerable to the energy required to operate it. We tested 15 refrigerators in homes in town under actual operating conditions and then several under controlled conditions in the laboratory. We found that frost did not change the energy requirement of a refrigerator one bit but did have a marked effect on the operating cycle. The thicker the frost on the unit the longer will be the period of operation when running and the longer will be the period that it will stay off. Very interesting curves, which were obtained with a recording ammeter in the line, show this. Other data included energy consumption for different temperatures maintained, causes of frost, humidity in the box, and best methods of removing frost.

We have done a considerable amount of investigating on laundry methods with the object of evaluating the factors in washing. Again this project started out as a test on washing machines and, strangely, the difference in makes and types of machines turned out to be the least important. Temperature of the water, softness of the water, amount of soap, and loading of the machine are much more important. The time period of washing was interesting, it being found possible to wash clothes too long, the dirt going back into them after 15 or 20 minutes. All of this work was done by a home economics girl, working on a procedure laid out by an engineer and under his supervision.

Out of these different problems we have come to believe that temperature is a most important thing in the household. Nearly every process has some temperature requirement and the studies on these, together with methods of control, will furnish much work in the future. Characteristics of thermostats make up a very interesting study alone.

In conclusion, may I say that household engineering research seems to fall into (Continued on page 406)

# New Developments in Roofing Nails

By James S. Maze

**A** ROOF cannot last longer or give better service than the nails which hold the roofing material in place. The bill for excessive roof depreciation on farms, due to improper nails, now amounts to about 20 million dollars annually.

There is very little that any of us can do to correct or replace improper nails now in use, for the renailing of roofs is not practical except in a limited way. However, we can do something for the roofs which are to be put on in the future. I should like in this paper to tell you about some of the troubles which improper nails cause, and then, if I may, to suggest the proper types of nails to advocate in your specifications, as a means of correcting these troubles in the future.

Any approach to this question of assisting farmers in the selection of proper shingle and roofing nails must be made with the understanding that it is purely an educational problem. Farmers have been in the custom of blaming the shingles or roofing when troubles occurred. Our problem is to show them that in nine out of ten cases, the trouble is due to improper nails, and that by using proper nails, although they may cost slightly more, the life of roofs can be greatly increased at a saving of money.

Let us approach the question, therefore, by first illustrating the savings which can be effected by the use of proper nails. Thousands of examples on record might be cited, but the cases of two roofs in central Iowa are perhaps as good as any.

These roofs were constructed with cedar shingles of exactly the same grade. The only difference was that roof A was laid with ordinary galvanized shingle nails at a total cost of \$7.00 per square, whereas roof B was laid with proper nails, as recommended by the shingle manufacturers, at a total cost of \$7.16 per square.

Roof A, with improper nails, had to be replaced in 10 years, due to the fact that the nails had rusted out. Roof B, with the proper nails, was not replaced for 20 years and then only because of alterations in the structure.

Presented before the Farm Structures Division at the annual meeting of the American Society of Agricultural Engineers at Urbana, Illinois, June 24, 1937.

Author: W. H. Maze Company.

Roof A, in its 10-year life, had cost its owner 70 cents per year per square. Roof B, in its 20-year life, had cost its owner only 35 cents per year per square, a clear saving of 35 cents per year per square, due to the use of proper nails.

The problem of nails for cedar shingles has been a subject of study and concern to the shingle industry for 30 years. It is purely a matter of education, for proper rust-proof nails are available.

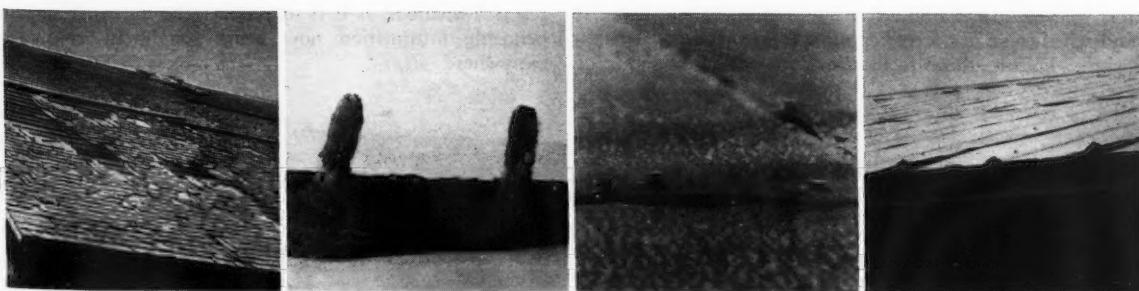
Proper nails for red cedar shingles are clearly defined by the shingle industry as follows:

*"Be certain that the nail that is chosen is actually hot zinc dipped. So-called 'galvanized' nails, bright and shiny, have a coating of zinc so thin that it is useless. The real zinc-dipped nail is not bright; it has a rather rough surface and is dull gray in color. A nail of this kind is really rust proof. If other 'rust-proofed' nails are offered, whether they be cadmium plated, brass plated or cement coated, do not accept them. Exhaustive tests, both in the field and in the laboratory, have definitely proven the enormous superiority of hot-dipped, zinc-coated nails."*

To those who may have occasion to prepare specifications for a red cedar shingle roof, let me give this word of precaution: Do not content yourself by specifying just "zinc-coated" nails. Zinc-coated nails are made in various qualities. The quality specified by the shingle industry is known as the "hot-dipped, zinc-coated" nail. This means a nail which has acquired its zinc coating by being dipped in pure molten zinc. Use the entire descriptive term "Hot-dipped zinc-coated", and it is well enough also, as an added precaution, to state frankly that this quality should properly cost the user around 2 cents per pound more than ordinary galvanized zinc-coated nails.

It is sometimes said that asphalt roofing protects nails from rust and consequently that no special precaution need be taken to secure high grade rust-proof nails for this type of roofing. Regarding the necessity for rust-proof nails with asphalt roofing, it is perhaps sufficient to say that most roofing manufacturers recommend hot-dipped, zinc-coated nails and are in a position to furnish them as a service to dealers who have no other source of supply.

A common trouble experienced with nails on asphalt



ROOF DAMAGE DUE TO FAULTY NAILS

(Left) A red cedar shingle roof from which many good shingles have blown off, due to rusting of the shingle nails and subsequent enlargement of the nail holes in the shingles. (Left Center) Rusted nails in a piece of asphalt roofing blown from a barn, illustrating the fallacy of the idea that asphalt roofing protects nails from rusting. (Right Center) Roll roofing nails backed out part way, permitting seams to open. (Right) A metal roof with nails backed part way out, typical of three out of four metal roofs

roofs is that nails back out or pop out, thus permitting the seams to loosen and leak. Just what causes this is not known. Some say it is the sun; others, the frost; but whatever the cause, it has long been a source of trouble and expense to users of asphalt roofings.

Today there is a nail which overcomes this difficulty. It is known as the spiral nail and has just recently been introduced. A number of the leading roofing manufacturers are packing this spiral nail, which is hot-dipped, zinc-coated, in their rolls of roofing. It is a nail with a spiral shank which twists in when driven and holds like a screw. When buying roll roofing, farmers should insist that the nails contained therein be spirals. If the roofing is to be laid over an old roof, the nails furnished will not be long enough. In this case, the user would do well to wait until his dealer can obtain spiral nails in the right length from the roofing manufacturer.

In the discussion of nails for cedar shingles and asphalt roofing, I have been able to recommend the qualities and types of nails which are universally approved as best by roofing experts, but in the case of nails for metal roofings I cannot do that for at the present time no single style or type of nail enjoys a similar approval, due to the fact that a new idea has recently been injected into this field of nails.

Heretofore, practically all specifications for applying metal roofing have stressed the importance of using a lead head nail, the object of which was to seal the nail hole in the roofing.

Recently, our company advanced the observation that the loosening of nails on a metal roof and resulting opening of the seams is a far greater source of leaks and trouble than any possible leaks through the nail holes. Studies were made showing that the area at the seams exposed to leak-

age on the average roof are about 200 times the area of the nail holes. In other words, driving rain directed at open seams has 200 times more opportunity of getting through than through the nail holes, assuming that the nail holes were open. In practice, of course, the nail holes are filled by the nail.

There are various ways to keep nails from drawing out. One way is to use a long nail and clinch it. However, most people feel that nails should be made in the beginning so that they won't draw out. That is what some of us on the manufacturing end are now trying to do.

There has been developed what is called a calk-screw nail. This nail doesn't carry a lead head. It is fabricated complete from a single piece of steel. When driven, it twists in like a screw. The unique feature of this nail is its cup head which mushrooms over the corrugation and locks the screw from twisting out backwards, an essential feature on any nail employing a screw shank.

A number of the lead head nail manufacturers have adopted the idea of a screw also, but with what success I am not prepared to say, for it would seem that lead would be too soft to lock the screw from twisting out backwards.

For our own lead head nails we have developed and adopted what we call an "anchor" shank which does not rotate when driven and consequently is adaptable to a lead head nail.

The point to bear in mind is that the most essential thing on metal roofs is a nail which holds securely. In my opinion it is more essential that a nail hold securely than that it carry any elaborate and expensive device for sealing the nail hole. Certainly the sealing of the hole has its place, but the main object of the nail is to hold the roofing in place. If it doesn't do this, it is of little value regardless of all other features.

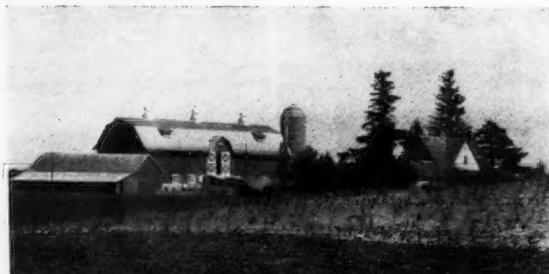
## Engineering the Household

*(Continued from page 404)*

four separate phases. First, the testing of equipment which should give considerable information, and, what is more important, should lead to side problems, that may have deeper research to them. We do not consider mere testing as research, but only a step in the procedure. Second, there is the establishment of standards of performance by which all pieces of equipment may be compared and progress noted. Third, the evaluation of factors in household processes. In this we seek to determine just how important any factor is and whether or not facts behind a factor need to be established. Fourth, there is the development of methods of

research, testing apparatus, or equipment itself. These are bound to be products of a research laboratory if the work aims deeper than just testing.

Household equipment research must be based on a broad program of testing, evaluation and development; must be done by a high type of research talent; must be directed by both home economics and engineering viewpoints; and must be accomplished under the soundest of research methods, if it is to produce the unbiased and dependable information now being sought by consumers everywhere.



# Drop Inlet Soil Saving Dams

By E. R. Jones

(Continued from August issue)

THE DROP INLET is characterized by a horizontal barrel through the base of an earth dam connected by an elbow to a riser to raise the intake chimney-like to the desired height. That height is such that the gradient from the lip of the riser to the lip of the gully does not exceed one per cent. The lowest fall through the structure, measured from the apron of the spillway outlet to the top of the inlet, is 10 ft in Wisconsin practice. The highest is 43 ft, but generally not over 30 ft. Except for a flared inlet and a flared outlet, the barrel and riser are square, and of the same inside size throughout.

*Locating the Site.* (Fig. 1, 2, and 3) Since the inlet of the riser must be level with or higher than the gully bank, the top of the earth dam must be several feet higher than that. Hence, the more rapidly the land surface rises on either side of the gully, the shorter and better the dam. It is better still where its top can be given increased width to serve as a farm lane or a public highway.

Generally the farther down the gully the dam is placed, the safer the downstream gradient, but the higher the dam must be to permit a height of inlet that will drown the lip of the gully. Fig. 3 shows how to locate the barrel across a projecting curve in one bank, but discharging in line with the center of the downstream tangent. The ease with which a flood can be by-passed around the barrel during construction more than compensates for the extra cost of excavating the trench for the barrel.

A detailed survey and a large-scale map of a dam site facilitates an accurate comparison of the merits of two sites that may be considered. The availability of desirable earth for fill at short haul, the ease with which the diversion channels can be made to enter the pond, and the alignment and gradient of the gully below the point of discharge are factors to be considered. A slight bend in the barrel to give

Second and concluding installment of a paper presented before the Soil and Water Conservation Division at the winter meeting of the American Society of Agricultural Engineers at Chicago, December 4, 1936.

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the discharge proper downstream alignment may be tolerated.

An excessive gradient in earth bottoms below the discharge may be met in either of three ways:

1 Constructing a concrete or masonry notch spillway about 100 ft downstream, the crest of which is one foot below the discharge apron of the major structure.

2 Attaching a drop outlet to the major structure.

3 Depressing the entire barrel. Because of the cost of excavation, this method is taken only where necessary to obtain sufficient head to give the tube the required capacity. Usually it is better to obtain the required capacity by selecting a tube of larger size.

*Capacity of Spillway.* When the pond fills with water and the discharge begins at the inlet, it operates as a weir with the second-feet of discharge computed for safety at  $3.5 LH^{3/2}$ , where  $L$  is the sum of the three open sides of the inlet, and  $H$  is the head causing flow, each measured in feet. With an  $H$  of 1 ft, the discharge is 3.5 sec-ft per foot of weir; 9.8 sec-ft for  $H$  at 2 ft; 18 sec-ft for  $H$  at 3 ft; 28 sec-ft for  $H$  at 4 ft, and so on. But long before a 2x2-ft inlet acquires an  $H$  of 4 ft, it is completely filled by the discharge, and its top is sealed from air. It then operates as a draft tube motivated directly by the vacuum in the riser. The velocity in feet per second is only about 30 per cent less than the square root of  $64 H$ , where  $H$  is the head in feet from the water level in the pond to the top of the barrel at the outlet. This  $H$  is distinct from the head in feet over the lip which is the height above the inlet at which it becomes sealed and the vacuum becomes effective. This height is called the design point of the structure. After this point is reached, the discharge increases but little with an increase in head, and the dam will overtop soon if the flow into the pond exceeds the capacity of the tube. To this extent, the capacity of a drop inlet is less flexible than that of open spillways in an emergency.

*The Flared Inlet.* A flared inlet reduces the height necessary to seal the inlet, but after that it does not have any advantage. It does, however, add to economy and safety of design. For a 4x4-ft with a 25-ft head, the flare reduces the head over lip from 4.75 to 3.25 ft. This allows either for a reduction of 1.5 ft in the height of the dam which permits a reduction of more than 10 per cent in the earth fill, or, if the dam is raised to the same height in each case, for 1.5 vertical feet of additional storage capacity in the pond, after the design point of the flared inlet has been reached.

Computations on the required capacity of the tube, however, ignore the storage capacity of the pond, because some day the pond will be filled with silt and have no storage capacity at all. To be sure, the water then may spread out and find some storage in a slowly moving sheet perhaps 200 ft wide and

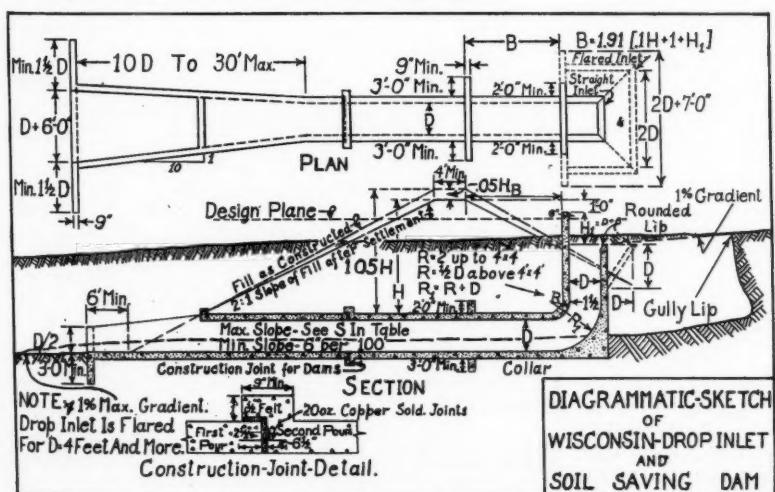
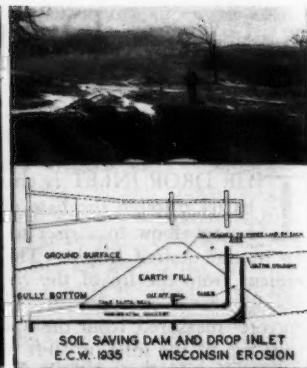


FIG. 2 (LEFT) A 3x3 DROP INLET WITH EARTH DAM AT EXTREME LEFT. (UPPER RIGHT) WHY FALLING WATER KEEPS A GULLY LIP ACTIVE. (LOWER RIGHT) DIAGRAMMATIC SKETCH OF SOIL-SAVING DAM AND DROP INLET



80 rods long above the inlet, but from the standpoint of safety it is best to ignore even that. The tube must be large enough that the dam will not overtop with the maximum 30-year runoff.

**Twin Tubes.** For large discharges, particularly with the lower heads, a twin tube of smaller size is better than a single larger tube. For example, a 5x5-ft with a head of 20 ft causing flow, and containing 82 cu yd of concrete, has a discharge of 650 sec-ft; while a twin 4x4-ft with the same available head and containing 89 cu yd of concrete has a discharge of 850 sec-ft. Hence in the twin structure, an increase of 8 per cent in the concrete yardage increases the discharge by 30 per cent. Other advantages of the twin structure are (1) greater spread of water at the outlet, (2) distribution of loads on the base, and (3) increase in the maximum gradient permissible in the barrel.

**Excluding the Air.** The back wall on the fourth side of the inlet prevents the formation of a vortex that would break the vacuum. The maximum gradient in the barrel is specified to prevent a greater velocity in the barrel than in the riser. Such an excess would permit the barrel to run less than full. Air would enter at the outlet and move in large bubbles up through the riser, thus retarding the flow.

**Forming, Mixing, and Pouring.** Collapsible inside forms in 4-ft sections, adapted to use by a contractor, reduce the cost of forming. Panels held in place by wedges may be used for outside forms. Lumber used for the flared outlet, inlet, and back wall can be used about six times before it is classed as waste. No. 3 white pine inch boards and 2x4-in pine are the stock used.

The 1:2:4 mix is standard. Washed aggregate is preferred. A one-bag mixer is the most convenient size. The mixer is set on one bank, and for the barrel, elbow, and lower part of the riser, the concrete may be placed from a chute. For the top of the riser and the back wall, wheelbarrows and scaffold are necessary. Thorough tamping of the concrete with a sharp bar is specified.

Materials for a cubic yard of concrete under favorable conditions are approximately:

|                                |         |
|--------------------------------|---------|
| 6 sacks of cement              | \$3.90  |
| 1/2 cu yd of sand              | .60     |
| 1 cu yd of gravel              | 1.20    |
| 90 lb of steel                 | 2.60    |
| Forms (15 per cent new lumber) | 1.00    |
| Total materials                | \$9.30  |
| Labor and accessories          | 10.70   |
| Total cost per cu yd           | \$20.00 |

**Steel to Support the Loads.** The top slab of the barrel must be strong enough to support the weight of the earth above it plus the frictional forces that are developed by the greater settlement of the higher column of earth at the sides of the culvert. Arbitrarily, on rock foundations, this

is taken as 125 lb per cu ft of earth over the top slab. The unequal settling due to the increased load at the center of the dam must be designed for, except on rigid foundations, unless some type of waterproof expansion joint is provided to permit deflection without cracking.

On the riser there are three forces to be considered: (1) the earth pressure, (2) the overturning moment caused by the greater load on the downstream side of the riser, and (3) the loads due to vacuum in the top half of the riser when flowing.

To meet these requirements, the amount of steel required ranges from 85 lb per cu yd of concrete in a 2x2-ft and a twin 6x6-ft, to 107 lb in a 4x4-ft. Strangely enough, it decreases both ways from the 4x4-ft, whether twin or single. The size and spacing of rods range from  $\frac{3}{8}$ -in round, 9 in apart for the inside stirrups of the first 12 ft of barrel at the outlet of a 2x2-ft barrel, and the same for the outside angle reinforcement of the first 40 ft of a 4x4-ft, to  $\frac{1}{2}$ -in square rods 4 in apart in the top slab of a 5x5-ft under a fill of 24 ft or more. Intermediate details are shown in Figs. 4, 5, 6, 7, and 8.

Wisconsin is justly proud of its pioneer work in testing, designing and constructing permanent soil-saving dams to meet conditions that render any other type of control unsafe. The work has been made possible by a staff of able, earnest engineers—civil engineers by training, hydraulic engineers by experience, but, by adoption, agricultural engineers in the highest sense of the term.

**Making the Fill.** Clean earth, free from sods and roots, is essential for earth dams. First, clear away all

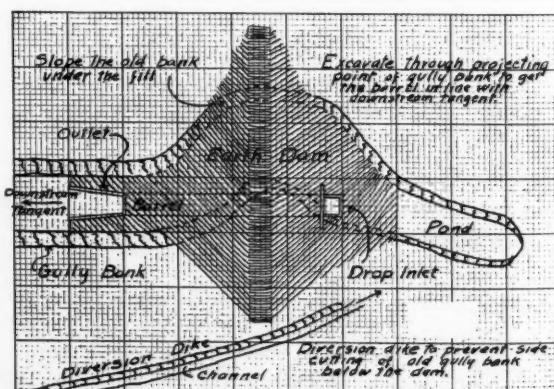


FIG. 3 GETTING THE BARREL IN ALIGNMENT WITH THE DOWN-STREAM TANGENT. ALSO PROVIDING FOR BY-PASSING THE RUNOFF DURING CONSTRUCTION

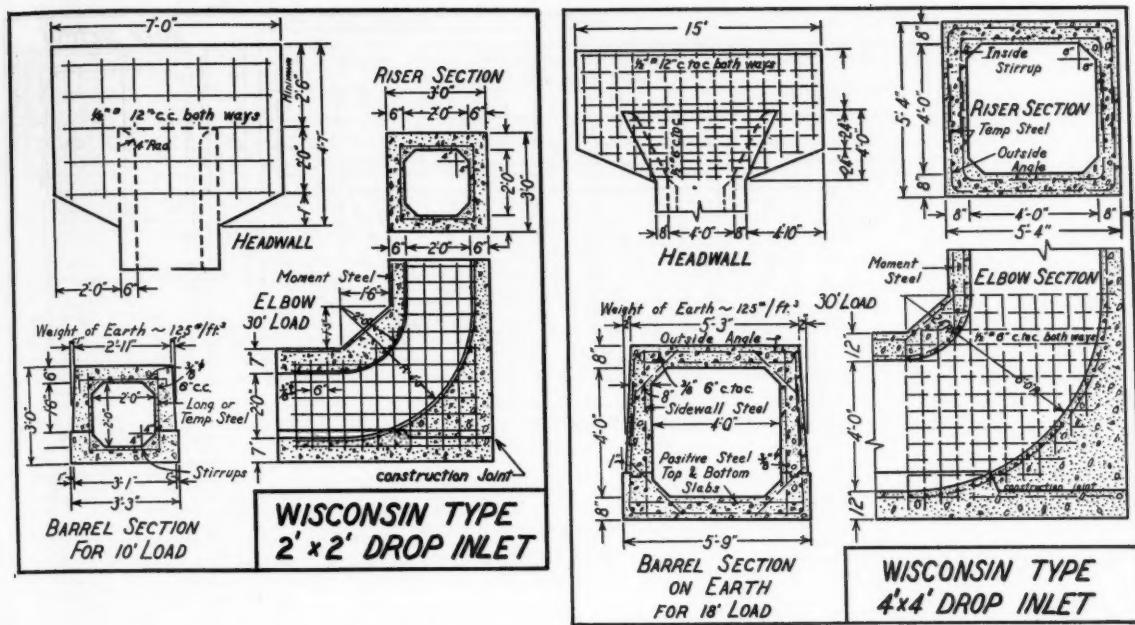


FIG. 4 (LEFT) THE SMALLEST SIZE OF DROP INLET ADVISABLE. FIG. 5 (RIGHT) ONE OF THE MEDIUM-SIZED DROP INLETS. REINFORCEMENT SHOWN TO SCALE

TABLE 3. CHARACTERISTICS OF DROP INLETS

| 2 x 2      |       |      |     |      | 2.5 x 2.5      |       |      |      |      | 3 x 3          |       |      |     |      |       |
|------------|-------|------|-----|------|----------------|-------|------|------|------|----------------|-------|------|-----|------|-------|
| Drop Ft    | $H_1$ | B    | S   | Q    | CY             | $H_1$ | B    | S    | Q    | CY             | $H_1$ | B    | S   | Q    | CY    |
| 10         | 2.50  | 7.6  | 2.4 | 80   | 17.0           | 2.80  | 8.2  | 2.3  | 120  | 21.5           | 3.20  | 9.0  | 1.8 | 170  | 30.0  |
| 15         | 2.75  | 8.6  | 4.1 | 93   | 20.0           | 3.15  | 9.3  | 3.3  | 145  | 25.0           | 3.60  | 10.2 | 2.7 | 205  | 35.5  |
| 20         | 2.90  | 9.3  | 5.2 | 104  | 23.5           | 3.40  | 10.3 | 4.2  | 162  | 30.5           | 3.85  | 11.1 | 3.4 | 234  | 42.0  |
| 25         | 3.05  | 10.1 | 6.2 | 112  | 27.0           | 3.60  | 11.1 | 5.1  | 177  | 35.0           | 4.05  | 12.0 | 4.2 | 256  | 48.0  |
| 30         | 3.15  | 10.7 | 7.2 | 120  | 30.5           | 3.70  | 11.8 | 6.0  | 190  | 40.0           | 4.25  | 12.8 | 5.0 | 275  | 55.0  |
| 2.5 x 3.5  |       |      |     |      | 4 x 4          |       |      |      |      | 4.5 x 4.5      |       |      |     |      |       |
| Drop Ft    | $H_1$ | B    | S   | Q    | CY             | $H_1$ | B    | S    | Q    | CY             | $H_1$ | B    | S   | Q    | CY    |
| 10         | 3.50  | 9.5  | 1.5 | 225  | 35.0           | 2.85  | 8.3  | 1.10 | 280  | 40.0           | 3.05  | 8.7  | 1.0 | 360  | 46.5  |
| 15         | 3.95  | 10.8 | 2.3 | 281  | 41.5           | 3.25  | 9.5  | 1.85 | 355  | 49.5           | 3.45  | 9.9  | 1.6 | 442  | 55.0  |
| 20         | 4.25  | 11.9 | 3.0 | 319  | 49.5           | 3.50  | 10.5 | 2.50 | 410  | 59.5           | 3.75  | 10.9 | 2.2 | 517  | 66.5  |
| 25         | 4.50  | 12.8 | 3.6 | 350  | 57.5           | 3.75  | 11.4 | 3.10 | 459  | 69.5           | 4.05  | 12.0 | 2.8 | 580  | 79.5  |
| 30         | 4.75  | 13.8 | 4.2 | 376  | 66.0           | 3.95  | 12.3 | 3.70 | 500  | 80.0           | 4.25  | 12.9 | 3.4 | 630  | 92.0  |
| 5 x 5      |       |      |     |      | 4 x 4 twin     |       |      |      |      | 4.5 x 4.5 twin |       |      |     |      |       |
| Drop Ft    | $H_1$ | B    | S   | Q    | CY             | $H_1$ | B    | S    | Q    | CY             | $H_1$ | B    | S   | Q    | CY    |
| 10         | 3.25  | 9.0  | 1.0 | 435  | 56.5           | 4.00  | 10.5 | 1.4  | 600  | 62.0           | 4.25  | 10.9 | 1.2 | 750  | 71.5  |
| 15         | 3.65  | 10.3 | 1.5 | 540  | 67.5           | 4.50  | 11.9 | 2.0  | 740  | 77.0           | 4.80  | 12.5 | 1.8 | 940  | 92.0  |
| 20         | 4.05  | 11.5 | 2.0 | 630  | 81.5           | 4.85  | 13.1 | 2.7  | 850  | 95.0           | 5.25  | 13.8 | 2.4 | 1080 | 113.5 |
| 25         | 4.35  | 12.6 | 2.5 | 710  | 97.0           | 5.15  | 14.1 | 3.3  | 940  | 113.0          | 5.60  | 14.9 | 3.0 | 1200 | 135.5 |
| 30         | 4.60  | 13.5 | 3.0 | 770  | 113.0          | 5.40  | 15.0 | 3.9  | 1025 | 131.5          | 5.90  | 16.0 | 3.6 | 1310 | 159.0 |
| 5 x 5 twin |       |      |     |      | 5.5 x 5.5 twin |       |      |      |      | 6 x 6 twin     |       |      |     |      |       |
| Drop Ft    | $H_1$ | B    | S   | Q    | CY             | $H_1$ | B    | S    | Q    | CY             | $H_1$ | B    | S   | Q    | CY    |
| 10         | 4.50  | 11.4 | 1.0 | 900  | 88.0           | 4.75  | 11.9 | 0.9  | 1100 | 106.0          | 5.00  | 12.4 | 0.8 | 1330 | 111   |
| 15         | 5.30  | 13.4 | 1.7 | 1160 | 113.0          | 5.50  | 13.8 | 1.5  | 1400 | 132.0          | 5.80  | 14.4 | 1.4 | 1670 | 142   |
| 20         | 5.60  | 14.5 | 2.2 | 1340 | 140.0          | 6.00  | 15.2 | 2.0  | 1620 | 161.0          | 6.40  | 16.0 | 1.9 | 1940 | 179   |
| 25         | 6.00  | 15.7 | 2.7 | 1490 | 169.0          | 6.40  | 16.5 | 2.5  | 1810 | 194.0          | 6.85  | 17.3 | 2.3 | 2175 | 219   |
| 30         | 6.35  | 16.8 | 3.3 | 1620 | 200.0          | 6.80  | 17.7 | 3.0  | 1990 | 232.0          | 7.25  | 18.6 | 2.8 | 2380 | 263   |

Drop means the fall in feet between the lip of the inlet and the floor of the outlet;  $H_1$  is the height of the back wall in feet, equaling head over lip plus 6 in;  $B$  is figured for a 5 per cent settlement, equaling 1.91 (0.05  $H_1$  + 1.0 +  $H_1$ );  $S$  is the maximum per cent of slope for the barrel;  $Q$  is the discharge in second-feet; and CY is the cubic yards of concrete in the structure.

Flared inlets for 4 x 4 and larger. The table contemplates straight inlets for the smaller sizes, but flared inlets may be used with no change in the table except that  $H_1$  would be about 0.5 less for a flared 2 x 2 and about 0.9 less for a flared 3.5 x 3.5. All twins are flared.

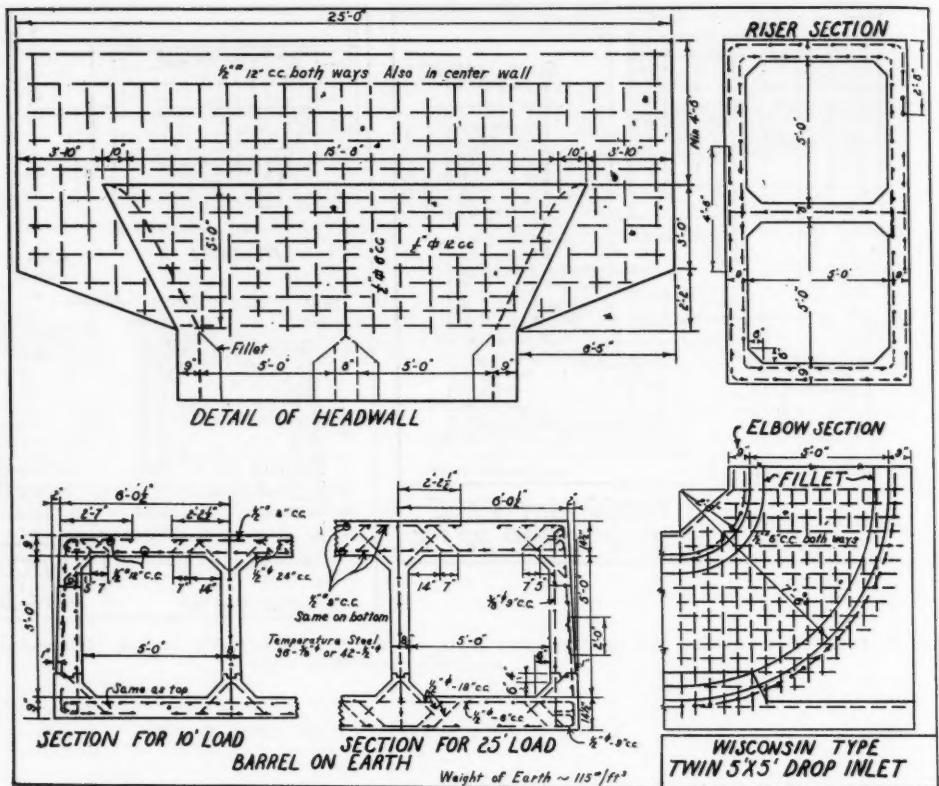


FIG. 6 ONE OF THE LARGER DROP INLETS. REINFORCEMENT SHOWN TO SCALE

rubbish from the base of the fill. Cut off all projecting points to avoid cavities under the fill. At the center line of the dam, across the bottom of the gully and up both sides, cut a core trench 4 ft wide at the top, 3 ft deep and sloping to a 2-ft bottom. Fill this with well-tamped clean earth, thus filling gopher holes and cracks that may be in the foundation. The foundation is then ready for the fill.

Place the fill in horizontal layers. Avoid building any part of it more than a foot higher than any other part at any one time. Horses or tractors pulling the slip scrapers, fresnos or revolving scrapers over the ground do sufficient

packing except near the barrel and around the cut-off wall where rigorous hand tamping is necessary.

The barrel and elbow are completed before the filling is begun. Construction of the riser is not begun until the level top of the fill is 6 ft, plus one and a half diameters, higher than the open top of the elbow. Then the riser and the fill are built up alternately 6 ft at a time, the fill in 6 one-foot layers, until the fill and the riser have reached their finished height. Thus, after each 6 ft section of the riser has been built, the fill is still at least one and a half diameters higher than the inlet. Port holes of generous

TABLE 4. TOP SLAB THICKNESS IN INCHES

| Size of barrel, ft | Feet of earth on top of barrel on downstream slope of dam |    |      |      |      |      |
|--------------------|---|----|------|------|------|------|
|                    | 5   | 10 | 15   | 20   | 25   | 30   |
| 2x2                | 6   | 6  | 6    | 6    | 6.3  | 6.7  |
| 2.5x2.5            | 6   | 6  | 6.7  | 7.3  | 7.8  |      |
| 3x3                | 7   | 7  | 7    | 7.5  | 8    | 8.6  |
| 3.5x3.5            | 7   | 7  | 7.5  | 8.3  | 9    | 10   |
| 4x4                | 8   | 8  | 8    | 8.5  | 10   | 11.4 |
| 4.5x4.5            | 8   | 8  | 8    | 9.8  | 11.5 | 13.3 |
| 5x5                | 9   | 9  | 9    | 11   | 13   | 15   |
| Twin 4x4           | 8   | 8  | 8    | 9.3  | 11.2 | 13   |
| Twin 4.5x4.5       | 8   | 8  | 9    | 10.8 | 12.6 | 14.5 |
| Twin 5x5           | 9   | 9  | 9.4  | 12   | 14.5 | 16   |
| Twin 5.5x5.5       | 9   | 9  | 10.5 | 13.3 | 16   | 18   |
| Twin 6x6           | 9   | 9  | 11.5 | 14.5 | 17.5 | 20   |

The bottom slab on earth is of the same thickness as that of the top slab. On rock, a bottom slab thickness of 6 in is uniform for all heights of fill and all sizes of barrel. Sidewall slabs have the same top thickness as the minimum for the top slab, but increase in thickness toward the bottom to effect an outside batter of  $\frac{1}{2}$  in per foot. Under the upstream face of the dam all slab thicknesses continue to the elbow at the same thickness as at the point of maximum load. The thickness of the riser walls is the same as the minimum used in the top slab of the barrel. The assumed load is 125 lb per cu ft.

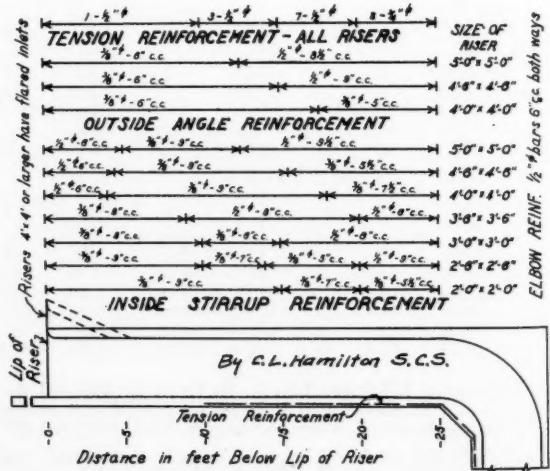


FIG. 7 REINFORCEMENT FOR RISERS, ALL SIZES UP TO 5x5. GUIDE FOR LARGER SIZES

| Height of Fill (in Feet) Over Top of Barrel                                     |   |   |   |   |   |
|---|---|---|---|---|---|
| 5   | 10  | 15  | 20  | 25  | 30  |
| 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         |
| INSIDE STIRRUP REINFORCEMENT  |   |   |   |   |   |
| 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         |
| POSITIVE STEEL IN TOP & BOTTOM SLABS  |   |   |   |   |   |
| 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         |
| OUTSIDE ANGLE OR STIRRUP REINFORCEMENT  |   |   |   |   |   |
| 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         |
| SIDEWALL STEEL  |   |   |   |   |   |
| 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         | 1/8" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2" 1/2" - 1/2"         |
| DESIGN ASSUMPTIONS:   |   |   |   |   |   |
| WEIGHT OF EARTH FILL = 125# per cu ft for "Projecting Condition"                |   |   |   |   |   |
| THIS CREST IS EARTH FOUNDATION ONLY   |   |   |   |   |   |
| HORIZONTAL PRESSURE = 50# per sq ft   |   |   |   |   |   |
| $\gamma = 1000$ $\rho = 62.4$ $V = 60$ $A = 200 \text{ ft}^2/\text{sq ft}$      |   |   |   |   |   |
| SPECIAL PROCEDURE REQUIRED:   |   |   |   |   |   |
| FOR LOCATION OF STEEL SEE FIG. 9  |   |   |   |   |   |
| FOR SIDEWALL THICKNESS SEE TABLE 4  |   |   |   |   |   |
| LONGITUDINAL STEEL  |   |   |   |   |   |
| 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" | 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" | 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" | 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" | 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" | 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" |
| 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" | 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" | 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" | 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" | 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" | 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" 2-1/2" - 2-1/2" |
| BARREL REINFORCEMENT FOR DROP-INLET SOIL-SAVING DAMS NEG. MIN. S.C.S.           |   |   |   |   |   |

FIG. 8 REINFORCEMENT FOR DROP-INLET BARRELS

size left in the upstream wall of the riser, later to be filled with concrete, are further assurance against over-topping the dam in the event of a flood during this critical period of construction.

TABLE 5. CUBIC YARDS OF EARTH PER LINEAR FOOT OF LENGTH OF EARTH DAMS. SIDE SLOPES 2 HORIZONTAL TO 1 VERTICAL

| Fill height, ft                           | 9    | 12   | 15   | 18   | 21   | 24   | 27   | 30   | 33   | 36    | 39    |
|---|------|------|------|------|------|------|------|------|------|-------|-------|
| For 4-ft wide top                         | 7.3  | 12.4 | 18.9 | 26.7 | 35.8 | 46.2 | 58.0 | 71.0 | 85.5 | 101.3 | 118.4 |
| Add for each additional foot of top width | 0.33 | 0.44 | 0.55 | 0.66 | 0.77 | 0.88 | 1.0  | 1.11 | 1.22 | 1.33  | 1.44  |

A man, team, and slip scraper can place from 15 to 20 cu yd of fill per day; a track-type tractor and revolving scraper 300 cu yd with a 200-ft haul. Other efficient equip-

ment for moving earth at longer distances is the power shovel loading on dump trucks. Usually, however, the fill must be started with horses and slip scrapers to pave the way for the heavier equipment.

**Protecting the Fill.** The hand sodding of both slopes of the fill has been found to be the best way to protect them from erosion. Occasionally the seeding of bluegrass with a nurse crop of grain has been successful, but generally sheet erosion and small gully erosion has defeated the purpose of the seeding before it developed sufficient surface protection. It may be necessary to haul water to keep the sod wet enough to take root during a dry season, but that is cheaper than to repair the damages of erosion common to grass seeding. Trees or brush have no place on the slope of an earth fill, because they shade the grass, so necessary for surface protection. Furthermore, the fibrous roots of bluegrass hold the earth more firmly than do the coarser roots of trees, and the wind leverage of tall trees is a detriment to the dam.

Rodents are a constant menace to the earth dam. Eradication of such pests in the neighborhood of the dam is the remedy. Fencing the slopes of the dam to keep a generous covering of grass at all times, and to prevent the uprooting of the sod, is another essential precaution.

**As Time Goes On.** After the pond has silted full and sodded over, it fits in well with the surrounding landscape. True, the pond can hold no more silt, but during a flood the water may spread out on the grassed surface 200 ft wide and 80 rods long, and at low velocity will drop most of its silt there. Assuming the watershed to be 300 acres, and that good cultural practices can reduce the erosion loss to one inch of soil in 20 years, this 6-acre flood plain will build itself up by sedimentation only 5 ft in 24 years. If, at that time, it appears that the sedimentation on the flood plain has reached the point of saturation, the dam and inlet may be raised 5 ft. This will start a second wave of sedimentation 5 ft deep or more up the valley, which because of the larger area covered at the higher elevation, may never become saturated. Siltation gradients in excess of 5 per cent are common.

**Do Drop Inlets Pay?** The value of a drop-inlet, soil-saving dam is measured primarily by the service it renders to the rest of the farm, or to the community. To the extent of the latter, it is reasonable that the community help pay for it. Factors contributing to its value are:

- 1 The acreage of low-slope agricultural land threatened by the advancing gully.
- 2 The inconvenience that would result to farms if cut into segments by the gully.
- 3 The menace to building sites and highways if the advance of the gully is not stopped.
- 4 The downstream damage of debris washed out of the gully.

(Continued on page 413)



FIG. 9 (EXTREME LEFT) JUST AFTER THE DROP-INLET, SOIL-SAVING DAM WAS CONSTRUCTED. (LEFT) ELEVEN MONTHS LATER, POND FILLED WITH SILT

# Farm Structures Research as a Basis for Promotion

By Henry Giese

**I**NTERPRETATION of this topic may hinge very largely upon our conception of just what constitutes research and promotion. At one of our ASAE annual meetings a few years ago Dr. Charles F. Kettering, director of research for the General Motors Corporation, gave us some very pertinent ideas as to what he termed research. He said that research is the process of finding out what you are going to do when you can no longer keep on doing what you are doing now. If we accept this definition in a general and perhaps rather loose sense, much of our present work would be classified as research, since we are constantly being obliged to change. Again he says, "The average man doesn't like change and the business man hates it a little more than others, but change is the immutable law."

Judging from the laboratory which Dr. Kettering operates, however, and from the results which come from his research efforts, I do not assume that he would dignify doing the next best thing as being research. On another occasion he stated, "Research is one of those things which is talked about more and understood less than any other industrial relationship. It is something which if you don't undertake until you have to, it is too late. It is just as though you waited to see the smoke rolling out of a building before calling the fire insurance agent. You have to pay the premium on insurance for a long time and really hope you will never need it."

In either of these expressions it would appear that a research program is entirely indispensable to a successful commercial organization. It seems likewise apparent that in order to serve its purpose, it must be purposeful and conscientiously carried out.

The term promotion also deserves some consideration. The dictionary says that to promote means "to cause to move forward toward some desired end." Obviously there are promotion schemes which would not be acceptable here and which would not well fit into a research program. Research implies a search for the truth and is not compatible with a wildcat scheme catering only to the profit motives of an unscrupulous manufacturer.

Quite in contrast to this, however, is what we should like to call promotion. In this modern age of division of labor, buying is just as essential in the life of an individual as is selling. A successful transaction must satisfy both buyer and seller. "Let the buyer beware" is a slogan of the past, and the conscientious manufacturer is jealous of the good name of his organization and its products.

With this conception of promotion, we think of better materials more skillfully used to meet farm housing requirements successfully and economically. In other words, research as a basis for promotion means a serious and well-conducted, fact-finding program which finds application in

Presented before the Farm Structures Division at the annual meeting of the American Society of Agricultural Engineers at Urbana, Illinois, June 22, 1937.

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the improvement of manufactured materials and higher quality in the final product, looking forward to well-equipped farms which will not only facilitate operation but contribute to the fuller happier life for farm people.

One of my boyhood thrills came from watching, with intense interest, the sparks fly from the village blacksmith's anvil. I fairly marveled as he welded one piece of sparkling steel to another. The development of special steels not easily manipulated in the small shop, the excellent stampings which make fewer repairs necessary and the availability of replacement parts cheaper than the cost of repairing the old, have proven disastrous to the small town tradesman.

I also recall the building of a neighbor's barn, with its great white pine timbers, some as large as 16 by 16 in, painstakingly mortised and tenoned together. When all was ready, the community gathered for a barn raising. A real tribute was due the carpenter if every piece fitted properly. This colorful practice has also disappeared. New materials and new construction details have changed procedure. Change, the immutable law, has made many of yesterday's methods obsolete. To what degree are we living in the past and to what extent can we continue yesterday's program? Shall we revel in the color of yesterday's work or rather in the discovery of new and better methods?

In the face of revolutionary industrial changes, where are we in the procession of progress? Can we point to improvements in farm housing practices comparable to those in the industrial world? If we are not so far behind as we might be, what are our plans for the future?

Have we materially reduced the labor charge for placing materials? Have we improved the design of the building or equipment so that the labor of operation is lowered? How many chickens, hogs or dairy cows can one man care for now as compared with a generation ago? Will our barns and granaries serve better and give longer production life?

An industrial agriculture requires just these things—buildings that will serve adequately. Competition demands reasonable first cost with low depreciation and maintenance. Upon whom can the responsibility for advancement be more directly placed than upon the agricultural engineer working in the farm structures field either for the colleges or for industry?

Aren't we all alibi artists? We do not have the equipment, or the money, or the time to carry on research. Isn't it all too true? But what does Dr. Kettering have to say about this? "The research problem is not solved with the apparatus, it is solved in a man's head. No one ever solved anything in a research laboratory. The research laboratory is the means by which, when a man has an idea clarified in his head, it is possible to do the solving of it. . . . So it isn't the apparatus that can be bought; it's the essential apparatus that is needed. But just to equip laboratories and do this and that and the other thing doesn't mean anything."

I believe that what Dr. Kettering is trying to tell us is that if we have a worth while idea, have analyzed it as

far as we can with what we have at hand, someone will be glad to see that the necessary facilities are forthcoming. We must first have a problem, and, second, a determination which cannot easily be put aside.

Have we a problem? Anyone who has conscientiously attempted to answer the various and sundry questions that come to agricultural engineering offices knows that he is frequently forced to indulge in half truths and hope that the inquirer does not press the matter further. Perhaps the difficulty is that we have not yet systematically attempted to clarify these problems and to organize them in tangible workable form. Or perhaps we are overwhelmed with the extent of the whole thing.

Many people appear disturbed over the capital expenditure for buildings and building equipment. Few industries attempt to operate without modern and adequate facilities. Are farm buildings an expense or an investment? Can the American farmer afford to attempt to use obsolete buildings in a questionable state of repair? Several years ago J. L. Strahan very ably opened this subject. Have we carried on?

An architect must very early establish the requirements which the building he is designing must fulfill. For years we have been engaged in designing farm structures not greatly, if at all, disturbed by the fact that we did not possess the knowledge of the specific housing requirements.

The third field or phase of research in which we should be engaged relates to the use of materials. Where could one look for greater appeal or opportunity for improvement? Nature has provided us with many structural materials. Some are suitable for construction as we find them, while others must be materially changed if they will suit our purpose best. We have an admitted housing shortage and still are not building as rapidly as the situation would seem to require. Why? Each material has definite properties which adapt it to some uses and make it less desirable for others. The very finest material may disappoint in performance because of either lack of knowledge or carelessness upon the part of the designer or builder. We are still far from the most effective use of these materials. Then there is the problem of construction. We only joke with ourselves when we continue to allow the tradesman to take such a heavy toll for merely placing it into the structure. He is not even serving his own best interests as competition exists not alone among the various materials but also among the many needs of man besides that of shelter for himself and his livestock. While complete mill

fabrication may not be near at hand, certainly we will see definite trends in that direction.

If we do recognize unsolved problems and have a determination to do something about it, what is the "catalyst" that we need to get the program in motion? Cooperation between the land-grant colleges and universities and the manufacturers of materials and equipment offer possibilities, as both groups should be vitally interested in improving products to be sold to the farmer. Industrially supported research in publicly maintained laboratories is common in Europe and appears to be increasing in this country. In this type of cooperation, the college usually makes available offices and appurtenances, laboratory space, equipment and library facilities, and furnishes the supervision. The sponsor provides a fund from which are supplied the stipend of a research fellow, materials, travel, and additional equipment. Ownership of results is shared by the cooperating organizations.

While there are some restrictions on projects which can be undertaken and competitive phases must be carefully avoided, Dr. H. L. Russell, former dean of agriculture of the University of Wisconsin, stated of their experience, "It is interesting to note that a large part of these funds are being used for research of a general fundamental nature. By far the larger part of the projects under investigation would be wholly within the purview of support from state funds."

In 1930 the advisory council serving in connection with a survey of research in farm structures sponsored by the U. S. Bureau of Agricultural Engineering, indicated the need for stimulating research and correlating the efforts of the various agencies thus engaged. Often the agricultural engineer interested in structures works alone. His research activities must be pushed aside for other routine duties. To carry on research with limited facilities and after other obligations are taken care of, requires courage and determination. A closer relationship among those of us who are endeavoring to do this sort of work would aid greatly in boosting morale, in raising the quality of work, and in making the work more effective.

In my estimation, research is indispensable to a program which will lead the way to better farm structures. The mechanics of securing this presents a challenge worthy of the best efforts of the Farm Structures Division of the American Society of Agricultural Engineers. There are many possibilities in co-operative effort between the colleges and industry.

## Drop Inlet Soil Saving Dams

*(Continued from page 411)*

Fig. 9 (left) shows a gully that was undermining a barn, wrecking a farmstead, and cutting a farm into halves. Note the fence posts for woven wire, the log dams, loose rock, and the remnants of brush dams that the farmer had labored to install during the ten years in which the gully head advanced 500 ft in spite of his efforts. There is not even a trace of the straw stack that was threshed into the gully one year for a dam. The owner had hesitated at putting in a metal flume to let the water slide down into the gully at a cost of nearly \$500, because experience had proved that even that might undermine. He did, however, prove to be a ready co-operator on an ECW project. In the background is a 5x5 drop-inlet, soil-saving dam with a drop of 10 ft that was completed in October 1933, at a

cost of \$1265, computing the 55 cu yd of concrete at \$1100, and the 550 cu yd of earth fill at \$165.

Fig. 9 (right) shows how in eleven months 10 ft of silt settled immediately above the dam, and over 6 ft opposite the barn, whose foundation it has saved. Two years later, the gully lip itself was submerged by sediment, and a wave of sedimentation is progressing up the valley.

Does it pay? The value of the dam is measured by the price of the farm, because there would not be much of a farm left if that gully had been allowed to run wild for the next ten years. Furthermore, the cost was less than that of all the temporary structures used in the futile ten-year fight against that gully.

## What Agricultural Engineers Are Doing

FROM THE USDA BUREAU OF AGRICULTURAL ENGINEERING

THE twin-furrow method of irrigation, which consists of running water in small shallow furrows one on each side of the crop row at a distance of about 6 in from the plants, is showing to advantage over the usual method of running water in a single furrow midway between the rows. This is the conclusion of Leslie Bowen who is conducting irrigation experiments at the Scottsbluff, Neb., experiment station. Benefits from the twin-furrow method are especially noticeable where small quantities of water are used.

Colin A. Taylor reports that the test on an orchard in North Pomona to show the modifying influence of a cover crop on the "June drop," of small orange fruits was carried through the month. Thermographs in standard shelters 5 ft above the ground surface have recorded day temperatures 5 to 7 F lower in the cover-cropped area than in clean-cultivated area. Night temperatures were about the same on both plots.

Tests are being conducted at Medford, Ore., by R. B. Allyn in an attempt to determine soil pressure resulting from soil moisture and its effect upon moisture absorption by heavy clay adobe soils. Preliminary studies are being made with air-dry and screened soil vibrated and tamped to a field volume weight condition. To get an idea of the maximum pressures developed and the corresponding effect on moisture absorption, the soil is enclosed in a cylinder 18 in in diameter, 12 in high, with  $\frac{1}{4}$ -in steel end plates held in place by 12 stay bolts running through the cylinder. The moisture is supplied under 7-ft head from an overhead calibrated bottle, and distributed by two horizontal rings of  $\frac{1}{4}$ -in perforated copper tubing. The water added is measured from the bottle and checked against the increased weight of the cylinder. The pressure is determined by means of a Goldbeck cell installed in the center of the cylinder with the pressure pipe and contact lead running through the top plate, the pressure being read on a bourdon gage at the instant sufficient air has been admitted to the cell to force its diaphragm away from an electrical contact, thus breaking the circuit through an ordinary flashlight. An attempt will be made to measure the variation in rate of moisture absorption under similar conditions but without volume restraint of the soil, and thus determine the effect of pressure. Finally, soil pressures under field conditions will be determined.

In connection with the supplemental irrigation program in the drought area of South Dakota, Carl Rohwer made arrangements with the WPA and the Corson County Commissioners for their cooperation in drilling a test well on property belonging to Corson County. A well 53 ft deep had previously been dug on this land, the discharge of which on July 1, was 20 gal per min. Because of the small flow it was decided to deepen the well. By the end of the month this well had been drilled to a depth of 283 ft. The first 100 ft of the well

### Contributions Invited

All public-service agencies (federal and state) dealing with agricultural engineering research and extension, are invited to contribute information on new development in the field for publication under the above heading. It is desired that this feature shall give, from month to month, a concise yet complete picture of what agricultural engineers in the various public institutions are doing to advance this branch of applied science.—EDITOR.

was in fine grained soft sandstone and the next 175 ft consisted of alternate layers of sandstone and shale. Some of these layers gave indication of good flows of water but in this area it is doubtful whether it will be profitable to drill to a depth greater than 100 ft.

Late in July L. G. Schoenleber planted cauliflower on Long Island, N. Y., in connection with a new fertilizer placement experiment. During the first week in August he also supervised the launching of a similar experiment with kale at Norfolk, Va.

A conference was held at Urbana, Ill., on August 2 and 3 to plan a new corn storage project which the Bureau is about to undertake in cooperation with the University of Illinois and Iowa State College. The conference was attended by E. W. Lehmann, W. A. Foster, and R. H. Reed of the department of agricultural engineering; Dr. W. L. Burlison, Dr. G. H. Dugan and Simmerl of the agronomy department, University of Illinois; Dr. J. B. Davidson and H. J. Barre of Iowa State College; W. B. Combs of the U. S. Bureau of Agricultural Economics, R. O. Snelling of the U. S. Bureau of Plant Industry; William MacArthur of the Agricultural Adjustment Administration; and Thayer Cleaver, C. K. Shedd, and Wallace Ashby of the U. S. Bureau of Agricultural Engineering. Preliminary arrangements were made for the experimental storage of approximately 10,000 bu of ear corn and 600 bu of field shelled corn, and for the study of 10 farm cribs in Illinois and 10 in Iowa.

A. D. Edgar spent the last week in July and the first two weeks in August in northern Maine, where he checked installation of instruments used in determining heat losses and condition of insulation panels in a potato house where the inside humidity is held at approximately 90 per cent. Mr. Edgar visited a number of new and remodeled potato storages with M. G. Huber, extension agricultural engineer, R. C. Dolloff, county agent leader, and Verne Beverly, county agent. Mr. Edgar then went to Lansing, Michigan, to arrange for studies of white potato storage in that state. Preliminary plans for this project had previously been made by Wallace Ashby with the Michigan Agricultural Experiment Station and Michigan Potato Growers Exchange.

Wilson P. Green is assisting in a transit

test of 10 carloads of oranges shipped from Colton, Calif., to New York City. Tests will be made on the relative merits of full-bunker icing of the refrigerated cars, as compared with upper half-bunker icing. Conductimeter readings will be taken to determine the relative insulating values of the walls of a steel car and a wooden car.

\* \* \*

A study of farm fencing conditions and new trends in fence construction is being made by M. A. R. Kelley. In this study he has made a field trip through the Carolinas and Georgia, thence west to Texas and is now on his way north through the middle west.

\* \* \*

W. V. Hukill is at Athens, Ga., where he is assisting J. W. Simons in studies of farmhouse comfort. Four one-room buildings for experimental use were completed in June by the Bureau and two buildings similar in plan but constructed of other materials are now being completed by the University of Georgia. To broaden the range of observation, the Bureau is now constructing an experimental unit which will be chiefly below the ground. Tests of effect of ceiling height and window and door areas and locations are being carried on in the three-room building constructed by the University of Georgia last year.

### From the State College of Washington

R. N. Miller reports that they have built what has been stated to be a most practical farm refrigeration plant. It is a large refrigerator which is operated at 0 degrees Fahrenheit for the freezing of meats, fruits, and vegetables for use on the farm. The cost of this refrigerator is within the means of many farmers and it should be very handy for most farms. For some of the farms they are suggesting a second large box in the basement, which would be kept at 33 to 36 F, and be used for cooling milk, storing eggs, etc., until such products are sold. From the same unit, a kitchen refrigerator at a temperature of 36 to 40 F is operated. They could not build as large a box as desired, and ship it, so they built one of 50-cu ft capacity. It weighs 1,040 pounds, presenting quite a problem of transportation.

### Agricultural Engineering Bibliography Issued

A BIBLIOGRAPHY on agricultural engineering has recently been published by the U. S. Bureau of Agricultural Engineering. It covers eight general divisions and fifty-two subdivisions of the field. Within each division or subdivision the references are grouped as to source, the sources including state experiment stations, the U. S. Department of Agriculture, state extension services, and miscellaneous publications of a public character. No attempt is made to cover the non-governmental publications in the field.

The booklet includes 373 mimeographed pages, and an author index. It is numbered 6016.

# NEWS

## North Atlantic Section to Meet at Toronto

TORONTO, ONTARIO, has been selected by the North Atlantic Section of the American Society of Agricultural Engineers for its annual meeting, October 12, 13, and 14.

Addresses, papers, luncheons, and a business session will occupy the first two days of the meeting. Inspection trips to electrified farms and to the Canadian plowing match, a luncheon tendered by the Massey-Harris Company, and the annual frolic of the Section are scheduled for the third day.

Program numbers already definitely scheduled include the following: "Welcome to Canada," by L. G. Heimpel; "The Dodo and Modern Agriculture," by W. C. Krueger; "White Man Farming—A Plan for Agriculture in the Northeast," by H. E. Babcock, former general manager of the Cooperative GLF Exchange; "Farm Building Plan Service for Northeastern Farms," by John R. Haswell; "'Cold' and 'Hot' Fences," by H. W. Riley; "Rural Electrification in Europe," by F. L. Rimbach; "Development of Light Engineering," by Mr. Hibben; "Farm Cold Storage," by E. L. Arnold; and "Modern Hay Making," by H. H. Tucker, New Jersey agricultural experiment station.

Additional subjects tentatively scheduled include air conditioning of farm buildings, the small combine, tractor design from the fuel standpoint, engineering schools for farm folks, adaptation of old machines to new jobs, practical irrigation in the East, and facts and fallacies about rural electrification.

Headquarters of the meeting will be at the King Edward Hotel in Toronto. Those

## Pacific Coast Section Fall Program

WALTER W. WEIR, secretary of the Pacific Coast Section of ASAE, has announced the Section's fall meeting program at Asilomar resort, Pacific Grove, California, Saturday, October 16, as practically complete.

Subjects and speakers already scheduled include "Farm Equipment for the Salinas and Pajaro Valleys," by C. F. Hollinger, manager, Farmers Mercantile Company, Salinas; "Orchard Heating," by F. A. Brooks, associate agricultural engineer, University of California; "Sterilization Lamps," by J. C. Rear, engineer, Union Ice Company, San Francisco; "Poultry Housing in California," by W. E. Newlon, specialist in agricultural extension, University of California; "Dehydration of Agricultural Products," by F. E. Price, agricultural engineer, Oregon Agricultural College; "Principles of Air Conditioning," by W. S. Weeks, professor of engineering, University of California; "Ground Water Conditions in Salinas Valley," by H. F. Cozzens, county surveyor, Monterey County, California; "Apple Storage," by F. W. Allen, associate pomologist, University of California; and "Hole Drilling Equipment for Soil Conservation," by Harry E. Reddick, regional conservator, U. S. Soil Conservation Service, Santa Paula, California.

attending the meeting will be granted a special rate of \$2.00 per day per person, for either single or double rooms, with bath. W. C. Krueger, Joseph S. Webb, L. G. Heimpel, and Frank H. Hamlin are the committee and section officers arranging the meeting.

## SAE Regional Tractor Meeting Features Tires and Rims

UBBER TIRES, wheels and rims, and testing equipment are to be featured in an SAE regional tractor meeting at Akron, Ohio, September 15, 16, and 17. Many ASAE members are scheduled to appear on the program, with information and viewpoints on both the agricultural and automotive angles to farm tire and tire equipment development.

At the opening session, on tractor and implement tires, C. E. Frudden will serve as chairman. J. D. Kreyen of the Firestone Tire and Rubber Company will present papers on "Implement Tire Problems," and "Special Applications of Tractor Tires," and H. W. Delzell will present a paper on "Water in Tractor Tires." ASAE members listed to contribute to the discussion include Martin Ronning, C. J. Scranton, E. E. Brackett, G. W. McCuen, and A. W. Clyde.

Elmer McCormick will be chairman of the wheel and rim session. A paper on "The Design, Production, Factory Handling, and Transportation of Tractor and Implement Wheels" will be given by John Ploehn. "Tractor and Implement Rim Problems" are to be covered by J. G. Swain, of Goodyear Tire and Rubber Company. "The Functions of the Tire and Rim Association" are to be explained by C. L. Wenzel, president of that organization. A. W. Lavers, L. B. Neighbor, and C. E. Frudden are listed among the discussers.

A. W. Lavers is chairman of the tractor tire testing session, which is to hear papers on "Results of Cooperative Tractor Tire Tests Made by the Rubber Industry," by

R. P. Gaylord of Goodyear Tire and Rubber Company, and "Another Method for Testing Tractor Tires," by A. W. Bull and M. K. Jessup of U. S. Rubber Products Company. O. E. Eggen, C. E. Frudden, Elmer McCormick, G. W. McCuen, A. W. Clyde, and E. E. Brackett are among the discussers for this session.

The program also includes factory trips, a rubber industry dinner and Cleveland Section meeting, a welding session, and a demonstration of tractor tire tests. The latter will be in charge of E. F. Brunner. J. E. Hale will be in charge of the trip through the Firestone factory.

ASAE members and others who are not members of SAE are welcome to attend and participate in the discussions. The Mayflower Hotel in Akron will be headquarters for the meeting.

## FEI Announces Program

OCTOBER 6 and 7 are the dates of the forty-fourth annual convention of the Farm Equipment Institute, to be held at the Palmer House, in Chicago. An entertainment program on October 5 precedes the business meeting.

Featured guest speakers include H. A. Schantz, president of the National Federation of Implement Dealers' Associations; Clifford V. Gregory, associate publisher of Wallaces Farmer, and Iowa Homestead, and of the Wisconsin Agriculturist; and Dr. Glenn Frank, editor of Rural Progress.

"Chemurgic Development Should Augment Farm Purchasing Power" is the title of an address to be given by C. B. Fritzsche, managing director of Farm Chemurgic Council. S. G. McAllister, president, International Harvester Company, is to address the convention on "Intangibles in the Implement Industry." H. G. Davis, director of research of the FEI, will address it on "State of the Industry."

Business of the convention will include an address by H. C. Merritt, chairman of the executive committee; a report of the secretary, Robert A. Jones; and a report by Fowler McCormick, chairman of the public relations committee.

## Washington News Letter

from AMERICAN ENGINEERING COUNCIL

GOVERNMENT reorganization, including all of the ideas advanced for a public works department, was left in the much tangled mass of unfinished business by the first session of the 75th Congress. It had the President's blessing, but the advantages to be gained by the elimination of duplication of work and the

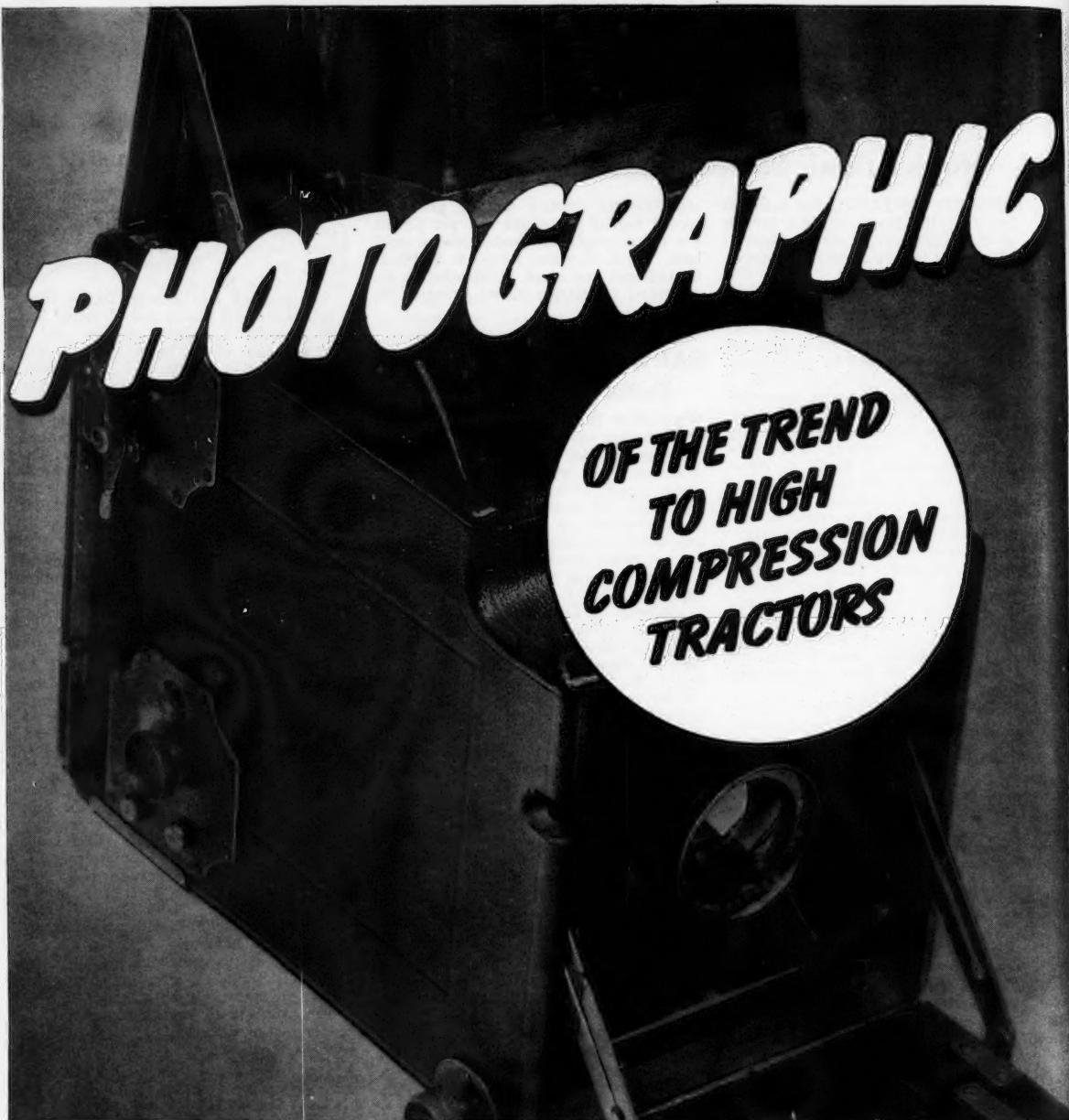
### ASAE Meetings Program

October 12-14 — Annual meeting, North Atlantic Section, Toronto, Canada.

October 16 — Fall meeting, Pacific Coast Section, Asilomar Resort, Pacific Grove, California.

improvements proposed for administrative procedure were handicapped by moves to effect radical changes in fiscal and personnel administration and discouraged by strong opposition from within the government agencies themselves.

Council's staff advised with the several committees on government reorganization and maintained close contact with those members of both Houses of Congress who had to do with the reorganization legislation. In spite of the very friendly relationship, however, the public works recommendation of American Engineering Council and of the President's Committee did not become an issue. No specific reason has been given for its omission from the general bills which were introduced, but it is believed to have been considered too provocative. (Continued on page 422)



**THESE PHOTOGRAPHS** are only a few of dozens that were taken this spring and summer on farms and in dealers' stores from Ohio to California. They and the accompanying statements point unmistakably to a mounting shift to high compression tractors. Farmers who owned high compression tractors proved to their satisfaction in field work that they got additional power, faster working speeds, and savings in fuel consumption. Dealers proved to themselves that

they could sell more of this kind of tractor, that the bulk of their sales was high compression tractors. In the face of such clearly proved sales results and satisfaction in actual use, it seems conservative to say that the high compression tractor is the fastest growing development in the tractor business today. Ethyl Gasoline Corporation, Chrysler Building, New York, manufacturers of anti-knock fluids for premium and regular gasolines.



The Caterpillar Diesel doing this bulldozing job is lubricated with Sinclair Ten-ol.

*for HEAVIEST WORK  
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Diesel Service Hours

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Wouldn't you like to keep your "Caterpillar" Diesel engine or tractor giving top-notch performance through many thousands of hours at lowest possible upkeep cost?

You can by using Ten-ol, the new, fused lubricant developed by Sinclair for "Caterpillar" Diesels.

Here's the proof. In laboratory tests with "Caterpillar" Diesel engines, more punishing than any service duty, and also in actual field operation, Ten-ol demonstrated that it gives ten

times more service hours than the finest straight mineral oil.

In 2000-hour heavy-duty, high-output wear tests, "Caterpillar" Diesels, lubricated with Ten-ol showed less than 1/10 the cylinder liner wear shown by similar engines lubricated with the finest "straight" oil.

Order Sinclair Ten-ol, Sinclair Diesel fuel and other Sinclair products from your local Sinclair office, or write Sinclair Refining Company (Inc.), 630 Fifth Avenue, New York, N. Y.

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**Sinclair TEN-OL** is recommended as a "new outstanding Diesel engine lubricant" by Caterpillar Tractor Co.

## Washington News Letter

(Continued from page 415)

Assuming that engineers generally agree that most public works are well designed, honestly executed, and administered without conscious or deliberate waste or extravagance, Council made the following statement to the Select Committee on Government Reorganization of the United States Senate, urging the establishment of a department of public works for the sake of economy in the conduct of government construction business; a public works department was also recommended as an ideal medium for the coordination of our engineering and construction resources during periods of economic depression and as a more effective means of mobilization for national defense:

"Engineers believe that the President should have effective managerial authority over the executive branch of the federal government commensurate with his responsibility under the Constitution of the United States, but they are not as concerned with strengthening the executive management system of the United States as a whole. They feel that the need for reorganization of the many agencies rests not only on the idea of savings, as considerable as they may be, but upon a very real need for a more economical and effective organization which could be more easily understood and controlled by the people. It is realized the reorganization of the many units of the executive branch of the federal government is an enormous undertaking, but engineers urge reorganization under direction of the Chief Executive on the basis of standards set up by Congress to provide up-to-date management for whatever activities may be decided upon by the people.

"Engineers have for many years favored the use of the merit system in personnel administration, and they now endorse the idea of expanding civil service to cover all non-policy determining positions. They recognize the civil service system as a valuable part of government management under a non-partisan civil service commission, and urge salary adjustments throughout the service so that the government may attract, and hold in a career service, men and women of the highest character and ability. Such a career is possible only when government service is concentrated and most of its positions are filled through civil service. In that way, opportunities for advancement open up to employees in the whole career system instead of the limited confines of a small service. Under such circumstances, engineers feel that direct appointments by the President should be reduced to a very small number of only the highest positions, and all other civilian positions should be filled by the heads of departments, without fixed term, through civil service with adequate tests to determine fitness.

"Engineers, who have made enormous contributions to the social advancement and economic welfare of their country and to civilization, feel that they are qualified by training and experience to advise their government regarding engineering and public works activities. On that assumption, they recommend the creation of a public works department to which the President should be authorized to transfer such major engineering and construction work for government agencies as may be practicable. Engineers believe that a public works department should be authorized to coordinate the

design, construction, operation, and maintenance of all large-scale public works which are not incidental to the normal work of other departments, to act as an agent of other departments on engineering public works, to administer federal grants to national, state, and local agencies for construction purposes, and to gather information with regard to public works needs and standards throughout the nation. They believe that a relatively small staff could and should direct such work in the hands of engineers in private business throughout the United States, without confusion and waste or the loss of valuable time.

"Such reorganization should promote efficient government in all of its branches, because it is now extremely difficult even for persons charged with executive duties and legislative responsibilities to properly comprehend many of the problems that arise among scores of scattered agencies. As related functions falling in the same field or having the same general purpose could be brought into organic connection and their operations made capable of consideration, as a whole, it should be easier for the chief executive to formulate programs for submission to Congress; and the Congress should be able to give more intelligent consideration to legislation and reach less hurried decisions regarding appropriations. The service agencies could perform their work with more certainty, and the public could more readily comprehend the work of the government, more directly exercise that general control which should obtain under a popular government, and more easily transact business with the government's agencies."

Excerpts were included from resolutions by the American Society of Civil Engineers and the American Engineering Council's Assembly to the effect that both organizations would support "the enactment of suitable legislation designed to create a federal department of public works, as proposed by the President of the United States, with definite provision for excluding the Army engineers and their river and harbor work from this department." It was also stated that existing working organizations need not be disturbed by the reorganization process, and that all questions involving the redistribution of duties should be subject to decisions by proper authorities in the light of subsequent experience and investigation.

\* \* \*

Council continues the distribution of releases on the Survey of Engineers and Engineering with the fifth in the series which carries the first section of what is believed to be the most comprehensive compilation of income data ever assembled regarding the earning records of a professional group of people. It is one of the results of a study made by the U. S. Bureau of Labor Statistics at the request of the American Engineering Council and its member societies. Additional copies may be obtained directly from Dr. Isador Lubin, Commissioner, Bureau of Labor Statistics, U. S. Department of Labor, Washington, D. C.

An analysis of the report reveals a number of interesting general facts about the earnings of 30,012 engineers who were actively engaged in engineering in 1929. Only 50 per cent were earning more than \$3,412 at that time. About 25 per cent were getting more than \$5,012 and only 10 per cent had incomes of more than \$7,466. On the other hand, 25 per cent were receiving less than \$2,509 and 10 per

cent were getting less than \$1,878. Although this is only a sampling of the engineering profession in the United States, those who are making the study believe the averages to be fairly representative.

## Personals

*George Arthur Rietz*, in charge of the rural electrification section, General Electric Company, was married August 14 to Miss Katherine Winters.

*John H. Scoltock* has been appointed project superintendent of the Humboldt County Rural Electric Cooperative, Humboldt, Iowa. He was recently connected with the U. S. Soil Conservation Service.

*Harold V. Wright* is now connected with the Agricultural Adjustment Administration, U. S. Department of Agriculture, as district performance supervisor for Georgia, his work being to check performance of field men who are checking compliance of farmers in the AAA program, and also to supervise mapping of farm land in Georgia by airplane table surveys and by aerial photographs. He was formerly connected with the extension service of the state of Georgia.

## Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the August issue of *AGRICULTURAL ENGINEERING*. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

*Woodrow Emerson Arrington*, construction engineer, Aberdeen Experiment Station, Aberdeen, Idaho. (Mail) 435 S. Main St.

*Harold H. Beaty*, extension assistant in agricultural engineering, Iowa State College, Ames, Iowa.

*James E. Boothe*, engineering aide, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 308 South Jefferson St., San Angelo, Texas.

*Leonard A. Brandrup*, time study, John Deere Plow Works, Moline, Ill. (Mail) 1418 12th Street.

*Richard E. Brown*, engineering aide, Soil Conservation Service, U. S. Department of Agriculture. (Mail) SCS Camp 13, Crewe, Va.

*C. F. Chouenhill, Jr.*, project engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Box 171, Lander, Wyo.

*John B. Greiner*, graduate assistant in farm electricity, agricultural engineering Department, Purdue University, W. Lafayette, Ind.

*Joseph T. Harrer*, engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 245 N. Washington St., Moscow, Idaho.

*Henry F. Miller*, sales manager, farm-suburban division, Goulds Pumps, Inc., Seneca Falls, N. Y.

*D. E. Washburn*, agricultural engineer, Ohio Edison Company, Springfield, Ohio. (Mail) 1015 N. Limestone St.

*John H. Zich*, apprentice, Allis-Chalmers Mfg. Co., Milwaukee, Wis. (Mail) 2818 W. Highland Blvd.

**TRANSFER OF GRADE**  
*H. N. Stapleton*, extension agricultural engineer, Vermont Agricultural Extension Service, Burlington, Vt. (Mail) 130 Robinson Court. (Associate to Member).

# Now Goodyear gives TEETH to TRACTORS

## New Sure-Grip Tractor Tire

### Brings Plus Sales Advantages to Tractor Manufacturers

A GREAT new tractor tire for the farmer. A powerful new selling aid for tractor manufacturers and dealers.

That tire is the new Goodyear SURE-GRIP Tractor Tire. Over 13,000,000 individual messages in leading farm journals will tell farmers about it and start them talking about it within the next 30 days.

It's a tire needed for many tractors—wanted by farmers—the surest-footed, hardest-pulling tractor tire ever developed for mud, wet clay or gumbo.

Look at its high, sharp, rubber cleats—the wide angle of pitch—the high, earth-gripping shoulders—all for extra traction!

It's husky, incredibly tough—designed for self-cleaning—made with chemically-toughened rubber to resist cuts and retain the sharp, biting edges of its cleats. And Supertwist Cord in every ply of its huge carcass gives it stamina unequalled in any other tire.

#### HORSE SENSE ABOUT FARM TIRE DOLLARS

Before the days of "rubber," as high as 40 different steel lug combinations were required to meet the many different soil conditions. So it's unreasonable to assume that *one* tractor tire can be best for all.

Goodyear developed the SURE-GRIP as a running mate for the famous All-Traction Tractor Tire. And Goodyear has developed other special-purpose tractor and implement tires—the most complete line of farm tires made—a tire for *every* soil condition.

Thus Goodyear offers you and your dealers sales and performance advantages not equalled by any other manufacturer: 1. Better tires for every type of soil. 2. Tires that will make your equipment perform more efficiently, hence, sell more easily. 3. Tires that more farmers prefer. 4. Tires that are backed by the greatest advertising and selling assistance.

Added up, these advantages mean that they'll help you and your dealers make more sales, more friends, more money.

THE GOODYEAR TIRE & RUBBER COMPANY, INC., AKRON, OHIO



**NEW SURE-GRIP**  
(Companion to the famous All-Traction Tractor Tire)

**SETS NEW HIGH IN DRAW-BAR PULL  
THROUGH MUD, WET CLAY AND GUMBO**



All-Traction  
Tractor Tire



Cane and Rice  
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Implement Tire



Ribbed Front  
Wheel Tractor  
Tire

**MORE FARM TRACTORS  
ARE EQUIPPED WITH  
GOODYEAR TIRES  
THAN ANY OTHER KIND**

# GOOD YEAR

PUT YOUR EQUIPMENT ON GOODYEARS!

# Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, senior agricultural engineer, Office of Experiment Stations, U. S. Department of Agriculture.

**THE USE OF BLUEGRASS SOD IN THE CONTROL OF SOIL EROSION.** R. E. Ublund. U. S. Dept. Agr., Farmers' Bul. 1760 (1936), pp. II + 13, figs. 9. This bulletin supersedes Leaflet 82, and is designed to further familiarize farmers with the various ways in which bluegrass may be used as a means of gully control.

**EQUIPMENT FOR APPLYING DUST FUNGICIDES TO SEED GRAIN.** W. M. Hurst, F. D. Fulton, W. R. Humphries, and R. W. Leukel. U. S. Dept. Agr. Circ. 415 (1936), pp. 20, figs. 12. The equipment described includes commercial treaters and experimental feeders. General precautions for handling fungicides are included.

**RELATIONSHIPS BETWEEN STOMATAL OPENING, LIGHT INTENSITY AND LIGHT WAVE-LENGTH [trans. title].** H. Harms. Planta, Arch. Wiss. Bot., 25 (1936), No. 2, pp. 155-193, figs. 15. The stretching and the first part of the motor phases of stomatal opening were not dependent on light intensity. Only with the attainment of a definite degree of opening did the stomatal reaction become affected.

As to the effects of wavelength on the stomata of the lower leaf surface of *Helianthus annuus*, *Calla aethiopica*, *Pelargonium zonale*, and *Ricinus communis*, the blue, green, and orange-red lights were equally active, while the blue and green lights were equally active on *Vicia faba* and *Tradescantia albiflora* (orange red being less so). In all plants tested, red light evoked smaller stomatal openings than any other wavelengths. With respect to the stomata of the upper leaf surface of *Helianthus* and *Ricinus*, the green showed no more activity than the blue light, the orange-red less than the green, and the red light caused only limited opening or none. By from 4 to 14-day adaptation of the stomata to blue and red light it was possible to change the influence of red light on stomatal movement in relation to the blue. The stomata in white areas of variegated pelargonium must be irradiated by the green or orange light at 1.6 to twice the intensity of the blue light to attain a similar degree of opening.

**SOLAR ENERGY AND ITS USE FOR HEATING WATER IN CALIFORNIA.** F. A. Brooks. California Sta. Bul. 602 (1936), pp. 64, figs. 29. This bulletin presents a technical analysis of the subject and reports the results of investigations on water temperatures and the rate of heating water in different solar heating systems.

It was found that enclosed 30-gal hot-water boilers with glass covers can be used as solar heaters without pipe-absorber coils and will furnish two or three hot showers per tank in the late afternoon or evening of bright sunshiny days. These tank absorbers do not keep their high temperatures over night and are not a satisfactory means of obtaining hot water for washing clothes.

The glass area of the ordinary pipe-coil absorber should be about as large in square feet as the number of gallons of storage-tank capacity. The 0.75-in pipes are conveniently spaced about 2.75 or 3 in, center to center, and usually should be arranged in parallel circuits to avoid excessive temperature rise. The length of single pipe of about 70 to 100 ft when the absorber discharges into the storage tank about 7 ft above the center of the absorber, gives over 30°F temperature rise, which is adequate. When the tank inlet is lower the single-pipe length should be reduced in proportion.

The insulated storage tank used with regular pipe-coil absorbers should have a capacity equal to the whole day's hot water demand because about half of the hot water is often used after sunset and about half is often needed early in the morning before the sunshine has time to heat much water.

To insure a constant supply of hot water regardless of the weather, the hot outlet pipe from the solar-heater storage tank can be connected to the cold inlet of an automatic auxiliary heater. Then if the solar-heated water is not up to thermostat-control temperature the automatic heater will operate to raise the temperature to the desired point. When there is good sunshine the water entering the automatic heater whenever a faucet is opened will already be hot enough, and the auxiliary heater need not operate. With such a combination system the housewife will never be bothered by lukewarm water, yet will save heating expense when the sun shines.

**AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE MISSOURI STATION.** J. C. Wooley, M. M. Jones, and G. W. Giles. Missouri Sta. Bul. 370 (1936), pp. 27, 28, fig. 1. The progress results are briefly presented of investigations on poultry houses, terrace outlet structures, and the economy of various tillage methods for the growing of corn in Missouri.

**AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE DEPARTMENT OF AGRICULTURE.** 1936 U. S. Dept. Agr., Sec. Agr. Rpt., 1936, pp. 95-98, 113-115. Progress results are briefly presented of investigations on improved farm equipment, improvement of farm homes, snow surveying, and road construction.

**STRENGTH, ABSORPTION, AND RESISTANCE TO WEATHERING OF COMMON AND FACE BRICK MANUFACTURED IN VIRGINIA.** J. W. Whittemore and P. S. Dear. Va. Engin. Expt. Sta. Bul. 26 (1936), pp. 32, figs. 2. The purpose of the investigation reported in this bulletin was to assemble and present authoritative information regarding the merits of Virginia manufactured bricks and their classification according to the latest tentative specification for the American Society of Testing Materials.

It was found that of the bricks submitted as salable by the manufacturers, 95.5 per cent represent bricks that are hard and well-fired, 95.5 per cent represent bricks that are resistant to weathering, 73.3 per cent are suitable for use where exposed to severe weathering such as severe frost action, and 17.7 per cent are suitable where exposed to ordinary weathering conditions. On the basis of strength alone, all of the bricks submitted pass the minimum requirements of the ASTM specifications.

**EQUIPPING A SMALL IRRIGATION PUMPING PLANT.** W. E. Code. Colorado Sta. Bul. 433 (1936), pp. 55, figs. 25. Practical information of a technical character is presented on the subject, together with data on the cost of pumping. Appendixes give data on the economical sizes of pipe and on pump selection.

**IRRIGATION OF CANTALOUPES.** W. M. Fleming. Sci. Agr., 16 (1936), No. 12, pp. 634-643, fig. 1; Fr. abs., p. 643. Applying different quantities of water to Hale Best cantaloupes growing at the Dominion Experimental Station, Summerland, B. C., it was found over a 3-yr period that 0.5 in weekly applications resulted in the greatest total yields and the largest number of high-grade melons. Chemical analyses of soil suggested that leaching of nitrogen from the upper soil layer may have been responsible, in part at least, for reducing yields on excessively irrigated plots. However, no significant differences were established in sugar content of comparable melons harvested from the heavily and lightly irrigated areas.

**VOLUMES AND WEIGHTS OF STACKED HAY.** H. E. Murdock. Montana Sta. Bul. 327 (1936), pp. 22, figs. 4. The results of the study of volumes and weights of stacked hay are presented.

The tests indicate that the actual volume of a haystack as ordinarily built can be closely estimated from measurements, but that the unit weight of hay varies between wide limits. A satisfactory mutual agreement should be entered into by the buyer and seller of stacked hay as to the method of arriving at the market value of a given volume of hay. The rate of settlement of hay is rather rapid for the first few weeks after it is stacked, after which time the volume remains fairly uniform until the hay is further packed by the winter snows and spring rains. This rate is apparently independent of the kind of hay, the stacker used, and the year. Rather definite relations were established between the volumes of a given stack at different ages. The range in the average weight per cubic unit of different kinds of hay is large. The range in the average weight per cubic unit of any one kind of hay is also large, and no rule can be made that will give an accurate estimate for any given stack. When a large amount of stacked hay is purchased the measurement of the stacks and estimate of weight may be fairly accurate, but where only a few stacks are involved there is much greater chance for error and weighing should be resorted to if at all possible.

(Continued on page 428)

# DECREASES WEIGHT . . .



# . . . INCREASES STAMINA

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## Agricultural Engineering Digest

(Continued from page 424)

**MASONRY BARN DESIGN AND CONSTRUCTION, H. Giese, H. J. Barre, and J. B. Davidson.** Iowa Sta. Res. Bul. 207 (1936), pp. 253-297, figs. 34. This bulletin reports the results of a study initiated in 1913 of the design of an all-masonry barn which might be constructed at reasonable first cost with the advantages of permanent and fire-resistant construction. The studies were confined largely to the roof. The basic principle of arches was used in the design of the roof, and reinforced concrete ribs were added for additional stability and to resist eccentric loads such as caused by wind.

In addition to a number of design studies, models of roof sections were built to develop a method of roof construction. Strength tests were made on roof models to check the reliability of the designs. The information obtained served as the basis of the design and method of constructing an experimental barn, which was built at Iowa State College in 1926-27. Common overall dimensions and a desirable roof shape were established to make the roof forms usable for a number of barns; wind load assumptions were adapted from reliable wind pressure investigations to permit a more intelligent and efficient roof design.

The results of the design studies and tests on models and roof sections and the construction of the experimental barn indicate that the masonry arch is a very stable type of roof structure. The tests on sections were found to check the design calculations closely.

The construction of the roof was found to be difficult and involves a large amount of labor because of (1) the use of heavy steel forms to carry a large part of the roof weight; (2) the manipulation of the forms in erection, moving, dismantling, and transporting; and (3) the handling and placing of roof materials.

The additional cost of the roof over a wood frame type construction is due not so much to the cost of materials as to the cost of the unproductive labor in handling the materials and in manipulation of the steel forms. The overhead cost of the forms becomes a large item in the first cost if they are used for only one or a few barns.

Experiments in the methods of making a roof watertight have not as yet indicated an entirely successful method. A heavy-fibered asphalt has been found the best of the waterproof coatings which have been used. Leaks appear to be due to slight openings in the joints and to the development of fine cracks.

A roof with a span of 34 ft and a height of 20 ft provides enough storage space for most conditions.

An important feature of this publication is the contribution it makes toward the principles of design of reinforced concrete arches as they relate to a roof suitable for a barn. Special attention is given to size, shape, and loading, and the structural principles relating to these are mathematically and graphically expressed.

**REPORT OF THE CHIEF OF THE SOIL CONSERVATION SERVICE, 1936, H. H. Bennett.** U. S. Dept. Agr., Soil Conserv. Serv. Rpt., 1936, pp. 52. This report presents the progress results of the work of the Soil Conservation Service during 1936, with particular reference to field and conservation operations, research, and cooperative relationships. The research program related to six closely coordinated lines of investigation in the factors involved in soil and water conservation and was organized to be cooperative with the state agricultural experiment stations.

**PROCEDURE FOR MAKING SOIL CONSERVATION SURVEYS.—OUTLINE NO. 4, APPROVED BY G. L. Fuller.** U. S. Dept. Agr., Soil Conserv. Serv., 1936, Outline 4, pp. III-32. Instructions are presented for use in making soil conservation surveys, including surveys on Soil Conservation Service projects. The instructions relate to base maps, symbols, differentiation of the four major land classification factors for conservation surveys, and reports.

**CONSERVATION FARMING PRACTICES AND FLOOD CONTROL, H. H. Bennett.** U. S. Dept. Agr., Misc. Pub. 253 (1936), pp. 16, figs. 15. A popular discussion is given of a few of the conservation farming practices found by experience and investigation to be effective in erosion control and which promise substantial aid to upstream flood control and soil protection.

**FARM AND COMMUNITY REFRIGERATION, E. L. Carpenter and M. Tucker.** Tenn. Engin. Expt. Sta. Bul. 12 (1936), pp. 63, figs. 20. This bulletin discusses the value, uses, designs, costs, and economical operation of refrigeration and refrigeration equipment for farms and rural communities in popular language.

**HARVESTING WITH COMBINES, W. M. Hurst and W. R. Humphries.** U. S. Dept. Agr., Farmers' Bul. 1761 (1936), pp. [2] + 37, figs. 13. Practical information is given on the development of the combine, the function of its various parts, its attachments, operation, and care. Information also is given on crop characteristics as they relate to combining problems.

**FOREST AND AGRICULTURAL INFLUENCES IN STREAMFLOW AND EROSION CONTROL, W. C. Lowdermilk.** U. S. Dept. Agr., Soil Conserv. Serv., [1936], pp. [1] + 37 + 4, fig. 1. This is a mimeographed summary review of literature up to 1930, the purpose of which is to set forth briefly the status of conclusions of investigators who have studied the problem and of experimental information on the subject as found in European and American literature.

**THE INFLUENCE OF THE CHARACTER OF THE PETROLEUM ON THE INITIAL TOXICITY TO WOOD DESTROYING FUNGI OF CREOSOTE-PETROLEUM MIXTURES, H. Schmitz.** Amer. Wood-Preservers' Assoc. Proc., 32 (1936), pp. 145-166, figs. 9. Studies conducted at the Minnesota Experiment Station are reported.

The initial toxicity of creosote-petroleum mixtures appears to be influenced not only by the initial toxicity of creosotes entering such mixtures, but also by the character of the petroleum in the mixture. Mixtures of petroleums of high specific gravity appear to be less toxic than mixtures of petroleum of lower specific gravity. Before this relationship can be accepted as established it will be necessary to make a more extended study of the subject.

**THERMAL EXPANSION OF TYPICAL AMERICAN ROCKS, J. H. Griffith.** Iowa Engin. Expt. Sta. Bul. 128 (1936), pp. 36, figs. 21. This bulletin reports research the purpose of which was to determine the coefficients of expansion of typical American rocks of the type used for building purposes through the moderate ranges of temperature usually encountered in building practice. Approximately 100 representative American rocks of varying chemical constitutions and diversified geographical locations were included in the study.

The expansions appear to be dependent upon the amounts of free silica in the rocks; the rocks having a maximum of free silica expand the most, and those with a maximum of combined silica expand the least.

There was a lack of conclusive evidence of the presence of inversions as indicated by inflections in the thermal expansion curves. Discontinuities in slopes of curves for natural silicates appear to arise from several structural discontinuities such as minute cracks or slip planes in specimens. The inversions appear to occur through a range of temperatures rather than abruptly at the theoretical 220°C expected.

An appendix includes thermal expansion curves.

**METHODS OF HEATING HOTBEDS, G. J. Stout, J. E. Nicholas, W. B. Mack, and D. C. Sprague.** Pennsylvania Sta. Bul. 338 (1936), pp. 22, figs. 10. This bulletin summarizes experiments conducted for 3 yr on the heating of hotbeds by electricity, anthracite coal, kerosene, manufactured gas, and fermenting manure.

Vegetable plants of satisfactory quality were grown in hotbeds heated by each of these means. It is evident that the use of any of these methods is practicable. The most important differences were economic, in cost of installation and operation, and in convenience and dependability. Hotbed heating appliances of any type must be properly installed in order to be economical and satisfactory. Proper insulation and weather stripping of electrically heated frames reduced energy consumption approximately one-half as compared with similar frames not insulated or weather-stripped. The method of installation of heating equipment also is important. Electrical energy consumption differed nearly 400 per cent among the several methods of installation studied.

Coal heating is probably better adapted for the use of large commercial gardeners than for home gardeners and small commercial growers because of the cost of installation and because the commercial heaters are larger than is necessary for hotbeds less than 200 sq ft in area. The advantages of this method of heating are a relatively low cost of fuel and convenience of maintenance.

The commercial use of kerosene or gas must await the development of burners suitable for this purpose.

Manure is probably the cheapest means of hotbed heating for many farmers, especially where the fertilizing and soil improving value of the spent manure is considered. It is generally available on farms and, when properly managed, supplies plant food and maintains a steady heat. The chief disadvantage of manure is that considerable care and skill are required for its most efficient use.

(Continued on page 430)



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## Agricultural Engineering Digest

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**SELECTED BIBLIOGRAPHY ON UPSTREAM ENGINEERING.** U. S. Dept. Agr., Soil Conserv. Serv., 1936, pp. [2] + 6. This mimeographed bibliography, prepared for the Upstream Engineering Conference held in Washington, D. C., September 22-24, 1936, contains about 70 references to literature on the subject.

**THE WISCONSIN SEED CORN DRIER.** F. W. Duffee. CREA News Letter [Chicago], No. 14 (1936), pp. 5-7, figs. 2. In a brief contribution from the Wisconsin Experiment Station the bin method of drying seed corn developed by the station is described and illustrated, it being pointed out that the bin method of drying seed corn is practical only for use by those who make a business of producing seed corn.

The equipment necessary for a bin drier is a furnace, a multi-vane blower, a series of bins, necessary power, and a suitable building. The furnace heats the air to around 100 F. The fan blows the air through the bins filled with corn.

The most satisfactory arrangement of bins has been found to be two rows of bins with an alley 3 ft wide between them. This alley receives the heated air from the fan and connects with the top and bottom of each bin. In this way the heated air can be conveyed to any bin as desired, and by means of dampers the direction of the air in any bin can be controlled.

Seventy-five per cent of the air which passes through the corn is brought back to the fan or furnace for recirculating. This cuts the fuel bill up to 50 per cent. The heated air is forced through the corn at a rate that does not allow it to make full use of its drying capacity.

A false slatted bottom made out of 1 by 4-in lumber placed edgewise and about 1 in apart is placed in each bin about 1 ft above the floor. This supports the corn and permits the air to flow underneath. Each bin has two dampers, one at the top and one at the bottom, connecting with the alley, and these are open when corn is being dried. On the outside is a door used for loading and unloading the corn.

**FARM ELECTRIFICATION STATISTICS.** September 30, 1936, CREA News Letter [Chicago], No. 14 (1936), pp. 2, 3. Tabular data are presented showing among other things, the farms in the United States having electric service on December 31, 1935, and on September 30, 1936.

**ALCOHOL AND ALCOHOL-GASOLINE BLENDS AS FUELS FOR AUTOMOBILE ENGINES—VI, STUDIES ON THE USE OF ALCOHOL-GASOLINE MIXTURES AS FUELS FOR A HIGH COMPRESSION EIGHT-CYLINDER AUTOMOBILE ENGINE.** A. L. Teodoro and E. K. Ong-sanoy. Philippine Agr., 25 (1936), No. 6, pp. 479-492, figs. 11. This is the sixth contribution on the subject from the Department of Agricultural Engineering of the University of the Philippines.

Studies were made to compare the performance curves of gasoline with those of alcohol-gasoline mixtures as fuels in an eight-cylinder automobile engine using high-compression heads. Two sets of cylinder heads were used, one set giving a compression ratio of 6.3 and the other a compression ratio of 7.5.

Using ordinary gasoline this engine when tested on the bench at a compression ratio of 7.5 could not develop more than one-half of the maximum power that could be developed at a compression ratio of 6.3. With four passengers as a carload and at a speed of from 20 to 35 mph higher mileage could be obtained with the use of high-compression heads than with low-compression heads. Detonation was very much in evidence when accelerating, when rounding curves, and when climbing hills. Unsteadiness in operation and loss of power were observed at speeds greater than 35 mph.

When using a mixture of 90 per cent gasoline and 10 per cent dehydrated alcohol, detonation was so heavy at full load that it was not possible to obtain constant operation for over 10 sec at any of the desired speeds. At three-fourths load using this mixture, and at full load using a mixture of 80 per cent gasoline and 20 per cent dehydrated alcohol, detonation was evident, though the engine could maintain constant load at the desired speed for about 30 min. No detonation was heard in any other tests.

The specific fuel consumption and the mileage obtained with mixtures containing from 40 to 60 per cent alcohol when using high-compression heads were nearly the same as those obtained with gasoline when using lower-compression heads. The mileage obtained with the mixtures containing from 10 to 40 per cent alcohol was greater than those with gasoline. The mileage gradually decreased as the percentage of alcohol increased from 10 to 40 per cent. The decrease in mileage was from about 1.8 to 4.5

per cent per every 10 per cent of alcohol added in the mixture with fuels containing from 40 to 95 per cent alcohol.

The maximum power developed at the highest speed on full load with high-compression ratio when using the mixtures was more than 10 per cent greater than the maximum power that could be developed at the same load with gasoline when using a compression of 6.3.

**CORN DRYING INVESTIGATIONS OF THE OREGON EXPERIMENT STATION.** F. E. Price and I. Branton. CREA News Letter [Chicago], No. 14 (1936), pp. 7-9, figs. 4. Experiments conducted at the Oregon Experiment Station on the dehydration of ear corn are briefly described.

Investigations concerned with the dehydration of ear corn proved that the problem became a simple one of forcing heated air through kilns of ear corn of a depth of from 2 to 3 ft. For drying corn to be used for feeding it was found that the maximum temperature of the air from the furnace may be 175 F.

Satisfactory drying of ear corn was accomplished by using from 75 to 100 cu ft of air per minute per square foot of kiln area. It was found possible to recirculate from 50 to 75 per cent of the air in the drying system, saving from 45 to 60 per cent of the fuel required with no decrease in the speed of drying.

The drier developed for the experiments was a vertical column, continuous process drier. Heated air was forced through two moving vertical columns of corn from a duct between the two columns. The drier was so designed that the thickness of the corn column through which the heated air was passed could be changed to determine the column thickness that would give best results.

Increasing the drier temperature increased the output of the drier per unit area of column space. For that reason it is desirable to operate at as high a temperature as possible without injury to the corn. A drier temperature of 175 was not injurious to the corn for feed. The shelled corn was dried in less than 1 hr in the continuous process drier at 175. In drying corn at temperatures of from 120 to 180 it is advisable to recirculate a considerable portion of the air in the drying system.

**ORCHARD BLOWERS FOR FROST PROTECTION.** B. D. Moses. CREA News Letter [Chicago], No. 14 (1936), pp. 9, 10, fig. 1. The results of service experiments on the use of blowers for the protection of orchards against frost are briefly reported in a contribution from the California Experiment Station.

**ELECTRIC PIG BROODERS.** J. R. Tavernetti. CREA News Letter [Chicago], No. 14 (1936), pp. 10, 11, figs. 4. In a brief contribution from the California Experiment Station experiments with electric pig brooders are reported.

Two of the brooders were of the radiant or light type, and two were of the underheat type. The light types consisted of 150-watt bulbs in 12-in white enameled reflectors placed over a hole in the top of a triangular-shaped hover 12 in high and 3.5 ft on the sides. The underheat type consisted of the same size and shape of hover, in which was placed an enclosed galvanized iron box 2 ft square and 2 in deep, in which were mounted open heating coils having a connected load of 100 watts. The brooders were placed in a corner of the regular farrowing pens from which the guard rails had been removed. A total of 10 sows farrowed in the pens containing the brooders—5 in the two with the light type and 5 in the two with the underheat type.

No difference was observed in the results obtained with the two different types of brooders, but the results show that 88.6 per cent of pigs farrowed in 1936 were raised to 10 days of age with brooders while only 81.7 per cent were raised without brooders.

**CHILI PEPPER DEHYDRATOR.** L. E. Holmes. CREA News Letter [Chicago], No. 14 (1936), pp. 20-22, figs. 6. This equipment as developed in southern California is described and illustrated, and some results of service tests are presented.

**AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE MICHIGAN STATION.** Michigan Sta. [Bien.] Rpt. 1935-36, pp. 5, 6, 14. Progress results are briefly presented of investigations on low cost paints and surface treatments, lime-treated shavings and sawdust for insulation, the use of a stem crusher as an aid in curing hay, designing a universal type cultivator, the conversion tractor, and standard methods of water analysis.

**ELECTRICAL VENTILATION FOR LIVESTOCK STRUCTURES.** C. H. Jefferson and D. G. Ebinger. Michigan Sta. Quart. Bul., 19 (1936), No. 2, pp. 81-87, figs. 4. Technical information is given on the design, installation, and operation of electrical ventilation systems for livestock structures.

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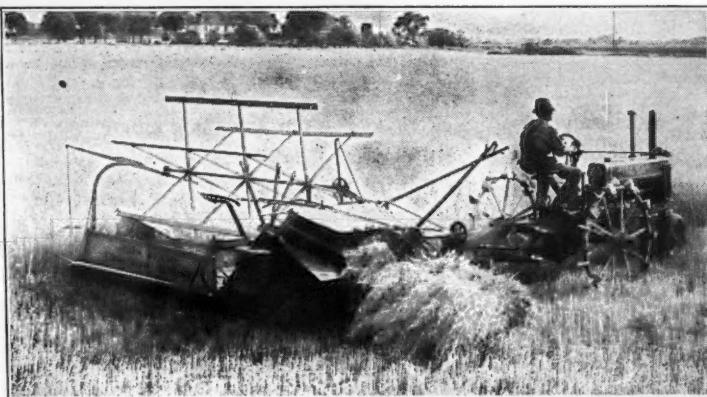
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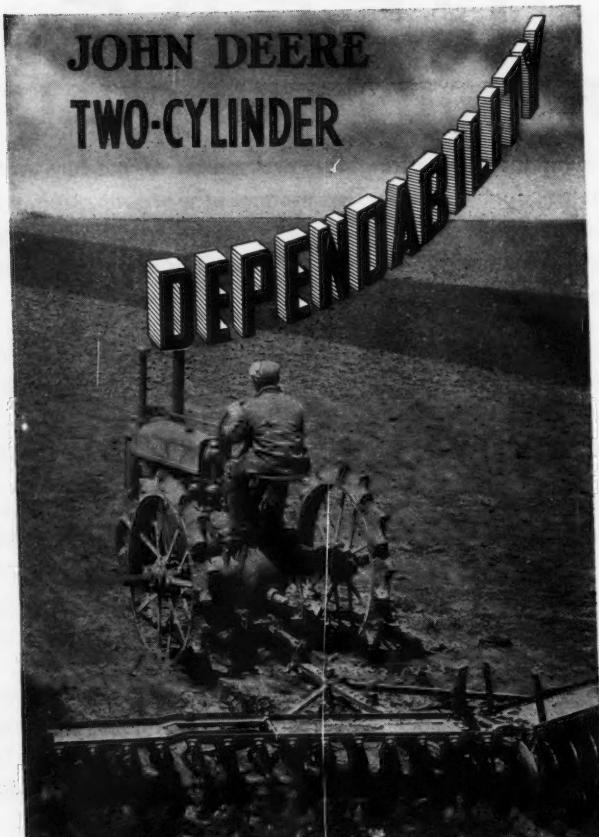
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## Books Received

**A B C OF AGROBIOLOGY**, by O. W. Willcox. Cloth bound, 5.5x8 in, 323 pages, 22 illustrations, indexed. W. W. Norton and Company, Inc., \$2.75. Subtitled "The quantitative science of plant life and plant nutrition for gardeners, farmers, and general readers," this book is a narrative of the development of agrobiology as a quantitative science, together with explanation of discovered natural laws of plant nutrition and quantitative growth. It is written for practical value to anyone with aesthetic, commercial, or scientific interest in plant growth. Contents, as indicated by chapter headings, cover what is agrobiology?, the indivisible kingdom of plants, thinking it out, the first agrobiologists at work, setting up the scale of soil fertility, graduating the scale of soil fertility, the fertility index, using the scale of soil fertility, source of frustration, the agrobiologic evaluation of water, the stand of plants, the quantity of plant life, more about the formula 318/N, looking at the limits, public soil science in the United States, review of the basal axioms, agrobiologic equilibria or end states, and mathematical details. An appendix gives "hints on fertilizers".

## EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted" or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

### POSITIONS OPEN

**DESIGNERS** and layout men familiar with grain, hay, and corn harvesting machinery wanted by a leading manufacturer of farm equipment. Must be high-grade men. PO-115

**DESIGNING ENGINEER** wanted by a farm implement manufacturer. Experience with plows, seeders, and general tillage tools is essential. Apply in care of ASAE, St. Joseph, Mich. PO-116

**ASSISTANT EXTENSION ENGINEER** wanted by agricultural extension service of middle western state. Should be graduate agricultural engineer of middle western institution with knowledge of modern soil and moisture conservation practices. Man with several years experience in soil and moisture conservation work preferred. PO-117

### POSITIONS WANTED

**AGRICULTURAL ENGINEER** wishes employment as instructor, head of department, or research worker in an agricultural engineering school. Has mechanical engineering training, industrial and extension experience, and a degree in agricultural engineering. Has also done considerable work toward a masters degree, and wishes an opportunity to complete the work. Is now employed, but wishes to make a change to the educational field. PW-279

**AGRICULTURAL ENGINEER** graduate of Kansas State College in the four-year course in agricultural engineering. Experience includes two years as camp engineer on erosion control work and two years in college extension in county agent and extension engineering work. Desires connection in college or industrial extension, farm machinery or farm management. Married. Age 24. PW-280

**AGRICULTURAL ENGINEER**, graduate of the University of Georgia, desires change. Prefers position in building work or on plantation. Experience includes sales, promotional, highway, sanitary, construction, geodetic, and subdivision engineering. Can furnish best of references. Write Box ABB, c/o AGRICULTURAL ENGINEERING. PW-281

**AGRICULTURAL ENGINEER** with a farm background desires employment in the field of soil erosion control, irrigation, or farm machinery. Educational or demonstrational work preferred. Holds a degree in agricultural engineering from a middle western university. Has one year's experience in highway engineering and three year's experience as a CCC camp engineer for the Soil Conservation Service. Has had considerable experience in contacting and working with farmers. Married. Age 28. PW-282